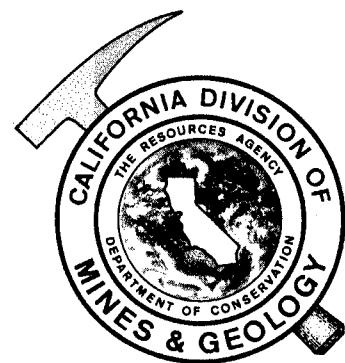


**COMPILATION OF STRONG-MOTION RECORDS
AND PRELIMINARY DATA FROM THE
IMPERIAL VALLEY EARTHQUAKE
OF
15 OCTOBER 1979**

1980

CALIFORNIA DIVISION OF MINES AND GEOLOGY

PRELIMINARY REPORT 26





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PRELIMINARY REPORT 26

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Illustrations and layout by Louise Huckaby.

PREFACE

This report summarizes California Division of Mines and Geology (CDMG), Strong Motion Instrumentation Program (SMIP) accelerograph records recovered from the 15 October 1979 Imperial Valley earthquake. All CDMG accelerograph stations that were triggered by the earthquake are listed in Table I. These stations with their respective ground accelerations and other pertinent earthquake data are arranged in order of increasing epicentral distance in Table II. Response data for structures instrumented by SMIP are presented in Table III. All CDMG stations recording 0.05 g or greater ground acceleration, which have been determined to be a significant earthquake record (CDMG, in preparation), are reviewed in detail.

ACKNOWLEDGEMENTS

CDMG extends appreciation to those agencies and organizations that have permitted installation of SMIP equipment on their property. We also wish to thank Albert Guyer, Harry LaGesse and Charles Turpen, CDMG-SMIP, Seismological Instrument Technicians, for their quick response in record retrieval and station maintenance after the earthquake. We are grateful to M.D. Trifunac and Vincent Lee for digitizing and processing records from the El Centro-County Services Building and freefield sites.

CAUTIONARY NOTE ON USE OF DATA

This preliminary data compilation has not been edited or reviewed for conformity with standards and nomenclature of the CDMG. Reasonable precautions have been taken to ensure accuracy of material presented; however, the preliminary nature of the data makes them all subject to change upon further verification. Distortions in the copies of records as shown herein make these copies unsuitable for measurements and scalings. Accurate photographic copies of the original records may be obtained from: Office of Strong Motion Studies, California Division of Mines and Geology, 2811 O St., Sacramento, California 95816.

ABBREVIATIONS

Organizations

CDMG	California Division of Mines and Geology
OSMS	Office of Strong-Motion Studies
SMIP	Strong Motion Instrumentation Program
CIT	California Institute of Technology
USC	University of Southern California

Instruments

CRA-1	Central Recording Accelerograph (Kinemetrics, Inc.)[film]
FBA	Force-balance accelerometer (Kinemetrics, Inc.)
RFT-250	Triaxial accelerograph (Teledyne Corporation)[film]
SMA-1T	Triaxial accelerograph with WWVB radio receiver (Kinemetrics, Inc.)[film]

Other

M _L	Local earthquake magnitude as defined by Richter (1958)
UTC	Universal Time Code
WWVB	Call letters for UTC radio station assigned by the Federal Communications Commission

Note:

Product trade names or trademarks used in this publication are intended for descriptive purposes only. Such use does not constitute endorsement by the California Division of Mines and Geology.

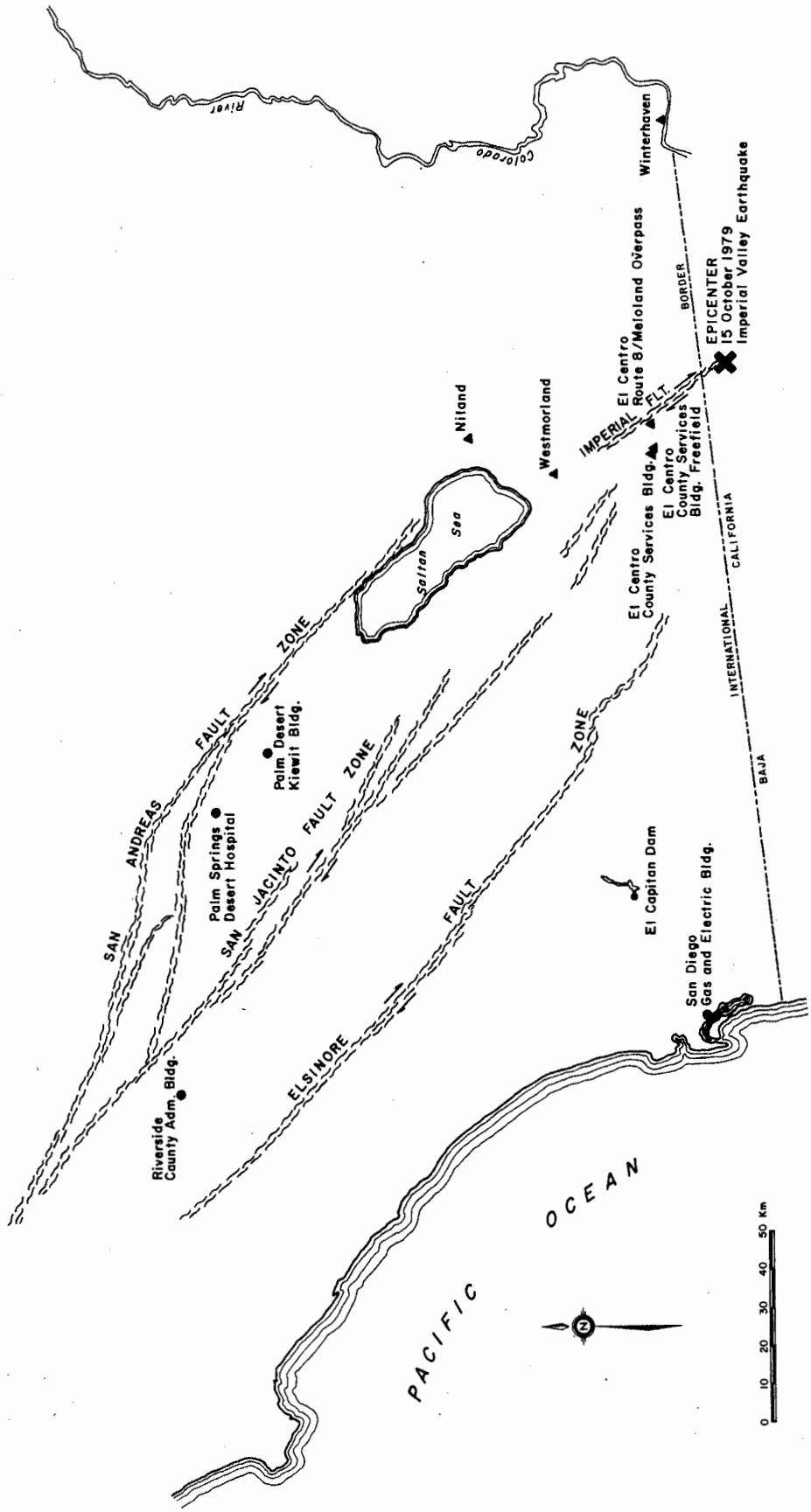
INSTRUMENT ORIENTATIONS

- | | |
|----------------------------|--|
| Direction | - Upward trace movement on film records indicate positive accelerations in the listed azimuth direction. |
| Stations not in Structures | - Orientation is in degrees azimuth (clockwise from north). |
| Stations in Structures | - Orientation is in quadrant notation with respect to a reference north. |

INTRODUCTION

A moderate-magnitude earthquake ($M_L = 6.6$, California Institute of Technology, Seismological Laboratory) occurred at 16:16 (PDT) on 15 October 1979, approximately 15.5 km east-southeast of Calexico, California (location map - page 2). The main shock, a shallow focus event centered in Baja, California, was located at 32.64°N latitude and 115.33°W longitude (CIT, Seismological Laboratory). The earthquake was generated by right-lateral slip on the northwest trending Imperial fault and produced approximately 30 km of surface rupture that extends northward from the international border into the United States.

Damage from the earthquake, estimated to exceed \$30,000,000, was most pronounced in residential areas of southern Imperial County and northeastern Baja, California. Agriculture also sustained high-dollar losses from seismic shaking and faulting. Much of the agricultural damage was generated by lateral slope failures into irrigation canals, including the All American Canal, that blocked and in places breeched these structures and subsequent crop damage resulting from insufficient irrigation. Much of the subsurface drain tile in fields cut by surface rupture was broken and will need to be replaced; in addition, many of these fields will need to be re-leveled to facilitate flood irrigation.



Region most affected by the 15 October 1979 Imperial Valley earthquake. All CDMG strong-motion stations that were triggered and recorded the main shock are plotted; triangles indicate stations that recorded significant ($> 0.05g$) ground motion. Imperial fault which moved during the earthquake and the main shock epicenter are noted. Fault data modified after Jennings and others (1975).

GEOLOGIC SETTING

The region most affected by the 15 October 1979 earthquake is situated in the central Salton Trough. The Salton Trough, an extension of the Gulf of California (Sharp, 1972; Morton, 1977), is a rhombochasm formed along strike of the southern San Andreas fault (transform) zone. The basin is extensively filled with several thousand meters of alluvium intercalated with lake bed deposits and volcanic rocks. The lowest part of the trough surface is approximately 84 m below sea level and is inundated by the Salton Sea.

All CDMG accelerograph stations in the Salton Trough are directly underlain by fine-grained siltstones and sandstones representing lake beds that were deposited in ancient Lake Coahuilla (ancestral Salton Sea). These lake beds are of Pleistocene to Holocene age and underlie lower surface terrane of the present Salton Trough. Basin alluvium and older fanglomerate deposits underlie the lake beds.

The San Andreas transform boundary (Atwater, 1970; Atwater and Molnar, 1973; Silver, 1974; Hileman and Hanks, 1975) between the Pacific and North American plates is defined by a zone of right-lateral strike slip faults in the Salton Trough. The Imperial fault, first recognized after the 18 May 1940 earthquake in this region (Buwalda and Richter, 1941; Ulrich, 1941), is an individual member of the San Andreas transform boundary and probably represents one of the most active branches of the fault system in Holocene time. Many investigators have subsequently described and mapped the Imperial fault (see, for example, Dibblee, 1954; Richter, 1958; Allen and others, 1965; Goultby and others, 1978; Real and others, 1979). Between 1843 and 1940 numerous earthquakes occurred in the Imperial Valley (Real and others, 1978a, 1978b; Toppozada and others, 1978, 1979). A few of these earthquakes were probably generated by movement on the Imperial fault. An eroded scarp 1 to 2 m high is locally prominent along segments of the 1940 and 1979 Imperial fault break indicating this zone of rupture has been prehistorically active.

STRONG-MOTION DATA

Thirteen accelerograph stations, instrumented by CDMG-SMIP, were triggered and recorded the 15 October earthquake. CDMG stations include freefield locations to monitor ground motion, multi-story buildings and a bridge to measure structural response. Records from these stations provide valuable acceleration data that will be used to evaluate damage-level motion from the earthquake.

The thirteen accelerograph stations that triggered and recorded the Imperial Valley earthquake are listed in Table I. All CDMG accelerograph stations recording significant strong-motion data (0.05 g - CDMG, in prep.) of the earthquake are located in the Salton Trough at epicentral distances of 70 km or less. Four of the stations that recorded significant records are regarded as freefield and two are instrumented structures. Three of the freefield locations are sited in one-story buildings which approximate a "freefield" condition; the fourth, the El Centro County Services Building freefield, is on its own reinforced concrete slab and housed by a fiberglass enclosure (T-hut). The most remote CDMG station that recorded a significant record is the Winterhaven-sheriff's substation located at the eastern boundary of the Salton Trough along the Colorado River.

GROUND MOTION

Ground motion data recorded at CDMG stations are listed in order of increasing epicentral distances in Table II. Acceleration data recorded by CDMG accelerographs suggest that strong ground motion from the 15 October earthquake decreased with increasing epicentral distance. However, a strong-motion network of USGS accelerographs indicates that for this earthquake strong-motion did not attenuate in a linear fashion at stations with epicentral distances less than 85 km (Porcella and Mattiesen, 1979). Similar relationships where ground motion does not attenuate in a linear fashion with increasing epicentral distance are described by many investigators (see, for example, Cloud and Perez, 1971; Jackson, 1971, Lysmer and others, 1971, Maley and Cloud, 1971, Hudson and Udwadia, 1974, Porter and others, 1979). This phenomena should provide for additional study of radiation effects from the Imperial Valley earthquake.

TABLE I

Alphabetical list of CDMG strong-motion accelerograph stations that were triggered and recorded the 15 October 1979 Imperial Valley earthquake.

No.	Station Name	Coordinates	Site Geology	Structure Type/Size	Instrument Location(s)
21	Blythe (Fire station)	33.61°N 114.71°W	alluvium	1-story bldg.	ground level
243	El Capitan Dam	32.88°N 116.82°W	granite	earth dam	abutment L & C crest
260	El Centro (Co Serv Bldg)	32.79°N 115.56°W	alluvium	6-story bldg	ground level 2nd,4th,roof
335	El Centro (Co Serv Bldg FF)	32.79°N 115.56°W	alluvium	T-hut	ground level
336	El Centro (Meloland Overpass)	32.77°N 115.45°W	alluvium	freeway overpass	ground level abutment,deck
331	Hemet-Stetson Palm (Fire Station)	33.73°N 116.98°W	alluvium	1-story bldg	ground level
23	Niland (Fire Station)	33.24°N 115.51°W	alluvium	1-story bldg	ground level
284	Palm Desert (Kiewit Bldg)	33.76°N 116.41°W	alluvium	4-story bldg	ground level 2nd, roof
299	Palm Springs (Desert Hospital)	33.84°N 116.54°W	alluvium	4-story bldg	basement 2nd, roof
312	Riverside (Co Admin Bldg)	33.98°N 117.37°W	alluvium	13-story bldg	basement 3rd,7th,roof
300	San Diego (Gas & Elect Bldg)	32.72°N 117.16°W	alluvium	22-story bldg	basement,3rd 12th,20th,roof
--	Westmorland (Temp) (Fire Station)	33.04°N 115.62°W	alluvium	1-story bldg	ground level
22	Winterhaven (sheriff's substation)	32.74°N 114.64°W	alluvium	1-story bldg	ground level

E1 Centro-Route 8/Meloland Overpass

The Route 8/Meloand Overpass is the closest CDMG strong-motion station to the earthquake epicenter and fault trace. A freefield ground vault 60 m west of the bridge center recorded peak accelerations of 0.25 g and 0.32 g horizontally and 0.23 g vertically. The horizontal accelerations are the highest recorded by CDMG. A peak horizontal ground-level acceleration of 0.33 g was recorded on the bridge foundation, however, this value is interpreted to be affected by structural input.

E1 Centro-County Services Building/Freefield

E1 Centro-County Services Building/freefield, the second closest CDMG strong-motion station to the earthquake epicenter, recorded 0.24 g for peak horizontal ground accelerations (2 channels) and 0.27 g vertically. The Imperial County Services Building is located approximately 100 m west of the freefield site and recorded peak ground accelerations of 0.29 g and 0.32 g horizontally and 0.19 g vertically. Higher horizontal ground accelerations at the County Services Building are interpreted to be from structural input.

The first 23 seconds of strong-motion record from E1 Centro-County Services Building/freefield have been digitized and processed at the University of Southern California (USC) using automated digitizing equipment and standard routine processing methods (Trifunac and Lee, 1973). Corrected accelerations, velocities, displacements and response spectra for all accelerograph traces at this location are presented in E1 Centro-County Services Building/freefield section of Ground Motion Data.

Summary

Recorded ground accelerations from the 15 October earthquake are probably common for moderate-magnitude earthquakes in Imperial Valley. The Salton Trough is an area subject to high seismic intensity that could result in major damage from large-magnitude events (Alfors and others, 1973). Bedrock accelerations of 0.5 g or greater are predicted (Greensfelder, 1974) for major seismic events in this region. Acceleration records of the Imperial Valley earthquake support published interpretations.

TABLE II

Earthquake ground motion data list for CDMG accelerograph stations triggered by the 15 October 1979 Imperial Valley earthquake. Stations are arranged in order of increasing epicentral distance.

No.	Station Name	Coordinates	Epicentral ¹ Distance (km)	S-T ² Interval (sec)	WWVB ³ Trigger Time	Acceleration Aximuth ⁴ Max(g) >0.1g (sec)	Duration ⁵ >0.1g (sec)
336	E1 Centro Rt 8/Meloland Overpass	32.77°N 115.45°W	18.3 [0.5]	2.5	16:59.5	N UP W	0.32 0.23 0.30
260	E1 Centro County Service Building	32.79°N 115.56°W	27.2 [7]	5.0	17:00	N UP E	0.29 0.19 0.32
335	E1 Centro County Service Building FF	32.79°N 115.56°W	27.2 [7]	5.0	16:59.9	92 UP 2	0.24 0.27 0.24
--	Westmorland Fire Station (Temporary)	33.04°N 115.62°W	52.0	5.4	n/a	180 UP 90	0.11 0.09 0.08
22	Winterhaven Sheriff Substation	32.74°N 114.64°W	65.7	*	n/a	180 UP 90	0.05 -- non operational
23	Niland Fire Station	33.24°N 115.51°W	68.6	5.7	n/a	90 UP 360	0.10 0.03 0.07
21	Blythe Fire Station	33.61°N 114.71°W	123.4	*	n/a	180 UP 90	0.02 0.02 0.02
24.3	E1 Capitan Dam (left abutment)	32.88°N 116.82°W	142.1	*	17:37.8	155 UP 65	0.02 0.01 0.02

TABLE II (cont.)

No.	Station Name	Coordinates	Epicentral Distance (km)	S-T ² Interval (sec)	MWVB ³ Trigger Time	Azimuth ⁴ Max (g)	Acceleration >0.1g (sec)	Duration ⁵
284	Palm Desert (Kiewit Bldg)	33.76°N 116.41°W	125.4	*	n/a	N UP	0.02 0.01	--
300	San Diego (S.D. Gas & Elect. Bldg)	32.72°N 117.16°W	171.9	*	n/a	S UP	0.03 0.01	--
299	Plam Springs (Desert Hospital)	33.84°N 116.54°W	174.4	*	n/a	E UP	0.01 0.01	--
✓ 331	Hemet-Stetson Palm (Fire Station)	33.73°N 116.98°W	196.2	*	17:32.5	W UP	0.02 0.01	--
312	Riverside (Co. Admin. Bldg.)	33.98°N 117.37°W	241.2	*	n/a	N UP	0.01 0.01	--

¹Distance from epicenter at 32.64°N latitude and 115.33°W longitude. Bracketed number is perpendicular distance to 1940 trace of Imperial fault; no bracketed number indicates station is greater than 40 km from mapped trace of Imperial fault. Reference: Ulrich, 1941; Jennings and others, 1975; Sharp, 1977.

²S-wave arrival minus trigger time.

* S-T is not recognizable.
n/a time code not available.

³Trigger time in minutes and seconds on Julian day 288, 23 hours (UTC) as determined from MWVB time code.

n/a time code not available.

⁴Azimuthal direction of ground acceleration for upward trace deflection on accelerogram (degrees clockwise from north).

⁵Time between first and last peak of trace registering greater than 0.10 g acceleration.

STRONG-MOTION RECORD DATA

STATION DATA

Name El Centro-County Services Bldg. FF Owner CDMG
 Address 940 Main Street
El Centro, CA. 92243
 County Imperial
 Number: CDMG 335 USGS -
 Coordinates: Latitude 32.793 °N; Longitude 115.564 °W
 Instrument(s)

Type (traces)	Serial Number	Date Installed	Date Removed
SMA-IT (3)	<u>2761</u>	<u>3/28/78</u>	<u>-</u>

EARTHQUAKE DATA

Name (Region) Imperial Valley earthquake
 Date 15 October 1979 Epicentral Distance: 27.2 km

SITE GEOLOGY

Site underlain by Quaternary lake bed deposits that are intercalated with alluvial fill of Salton Trough. Perpendicular distance to Imperial fault is 7 km.

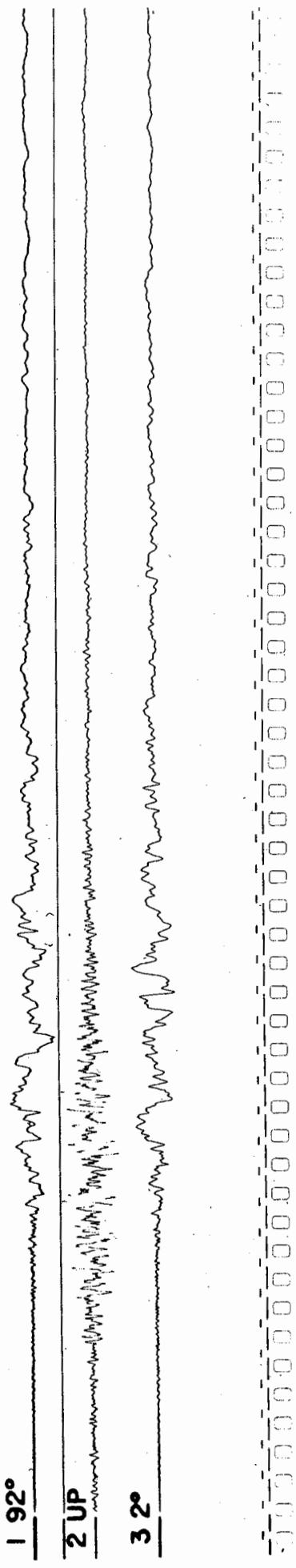
TRACE EVALUATION/DATA

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% Crit)	Peak Acc. (% g)
1	92	17.7	26.6	57.9	23.7
2	UP	18.4	26.2	58.1	26.6
3	2	17.9	26.6	62.7	24.3

Structural orientation reference: North = n/a °

EL CENTRO CO CENTER FF CDMG #3335
STATION 32.793°N-115.564°W
EQ 10/15/79 (2316) EQ 32.62°N-115.33°W

3 Chs Copy Scale (1cm)
SMA-T/2761 Film Speed = 2 time mark/sec
Mag 6.6 (CIT)

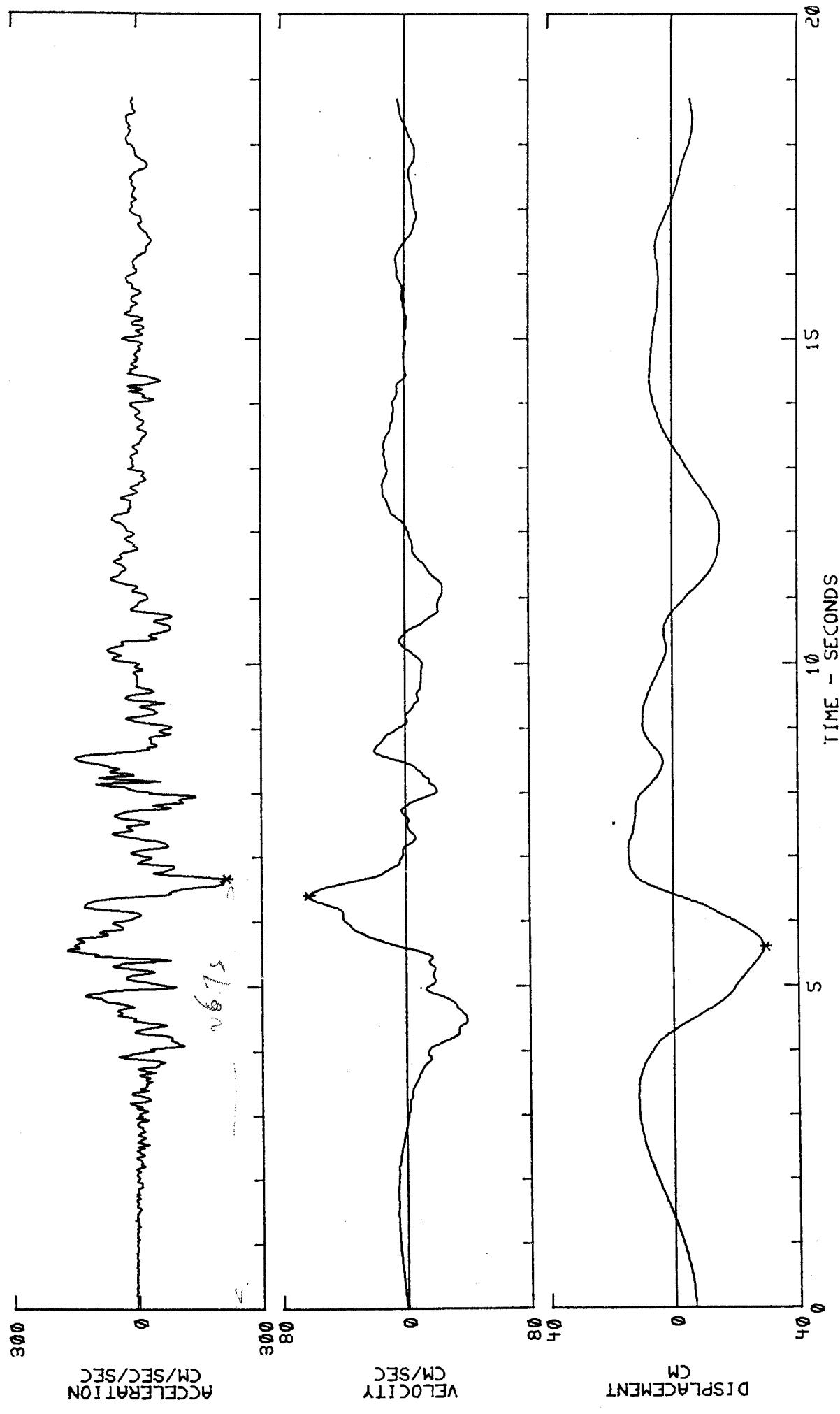


IMPERIAL VALLEY EARTHQUAKE, EL CENTRO, CAL. OCT 15, 1979 - 1616 PDT

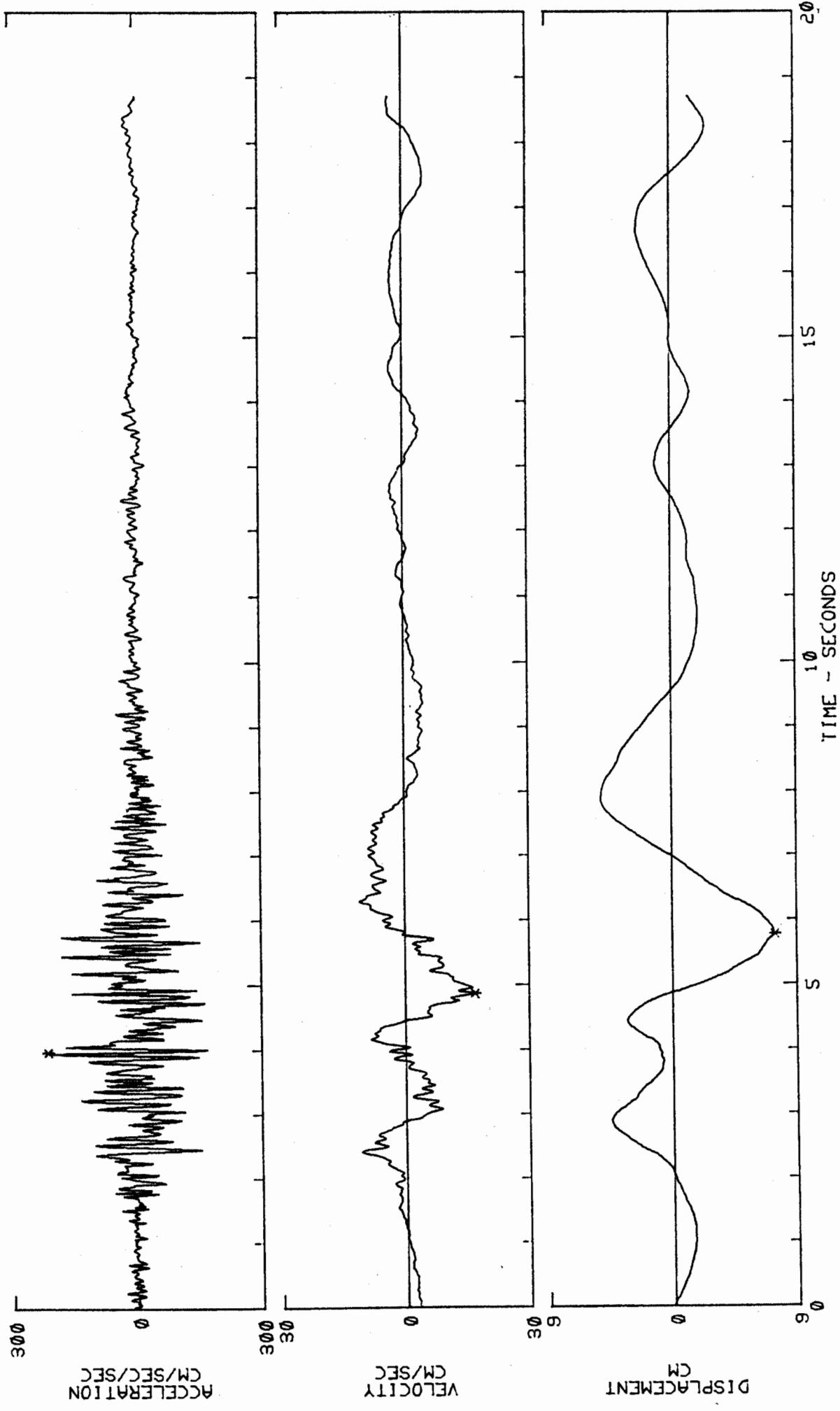
TAQ#2 79.002.0 EL CENTRO CO CENTER FF. EL CENTRO, CALIFORNIA COMP NNE

ACCELEROMGRAM IS BAND-PASS FILTERED BETWEEN 0.095-0.125 AND 25.00-27.00 CYC/SEC.

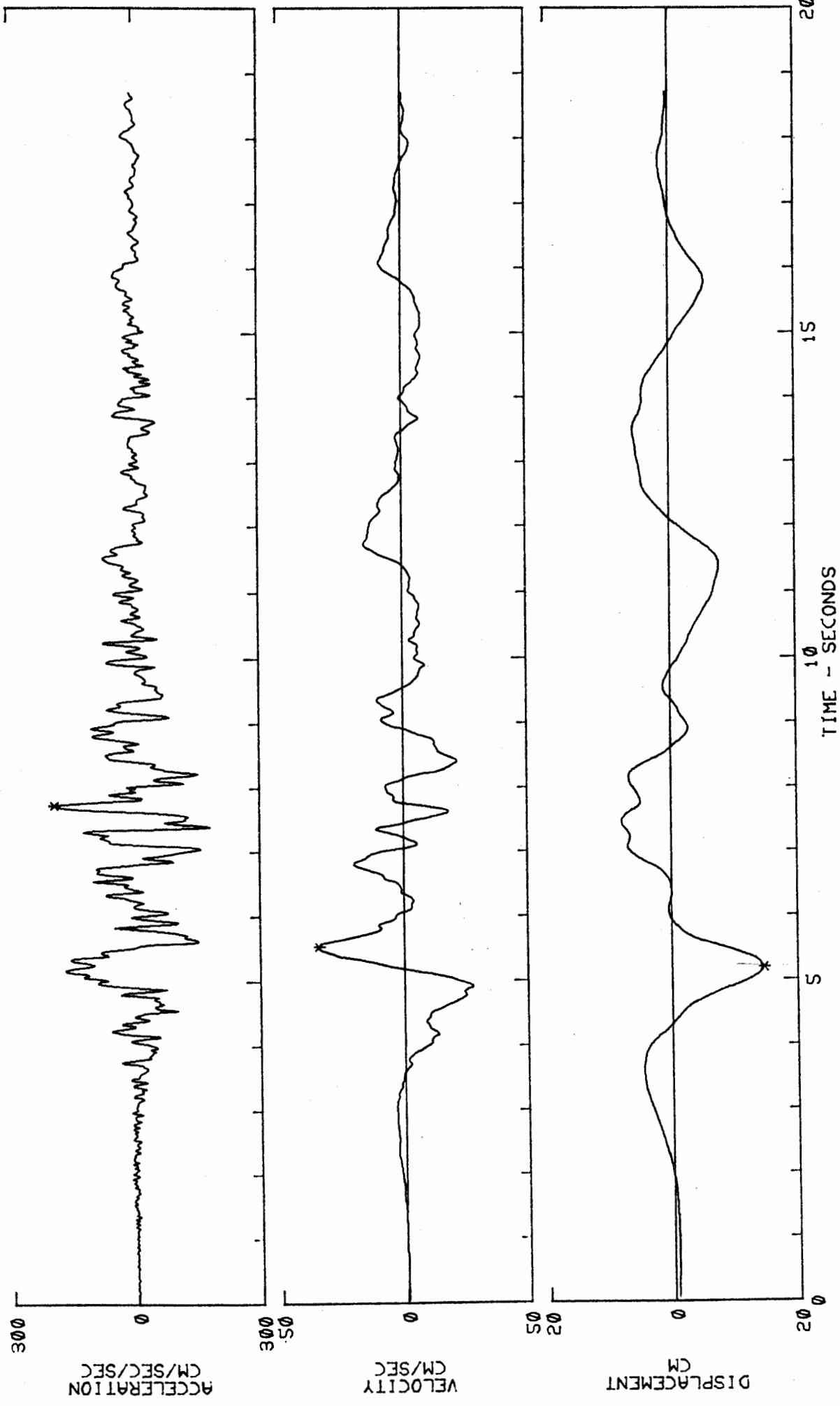
*PEAK VALUES : ACCELERATION = 215.2 CM/SEC/SEC VELOCITY = -62.8 CM/SEC DISPLACEMENT = 29.3 CM



IMPERIAL VALLEY EARTHQUAKE, EL CENTRO, CAL. OCT 15, 1979 -1616 PDT
 STA 02 79.002.0 EL CENTRO CO CENTER FF, EL CENTRO, CALIFORNIA COMP UP
 ACCELEROMETER IS BAND-PASS FILTERED BETWEEN 0.095-0.125 AND 25.00-27.00 CYC/SEC.
 *PEAK VALUES : ACCELERATION = -216.4 CM/SEC/SEC VELOCITY = 16.8 CM/SEC DISPLACEMENT = 7.37 CM



IMPERIAL VALLEY EARTHQUAKE, EL CENTRO, CAL. OCT 15, 1979 -1616 PDT
LIA002 79.002.0 EL CENTRO CO CENTER FF. EL CENTRO, CALIFORNIA COMP N0RE
ACCELEROMGRAM IS BAND-PASS FILTERED BETWEEN 0.095-0.125 AND 25.00-27.00 CYC/SEC.
*PEAK VALUES : ACCELERATION = -194.6 CM/SEC/SEC VELOCITY = -34.6 CM/SEC DISPLACEMENT = 14.6 CM



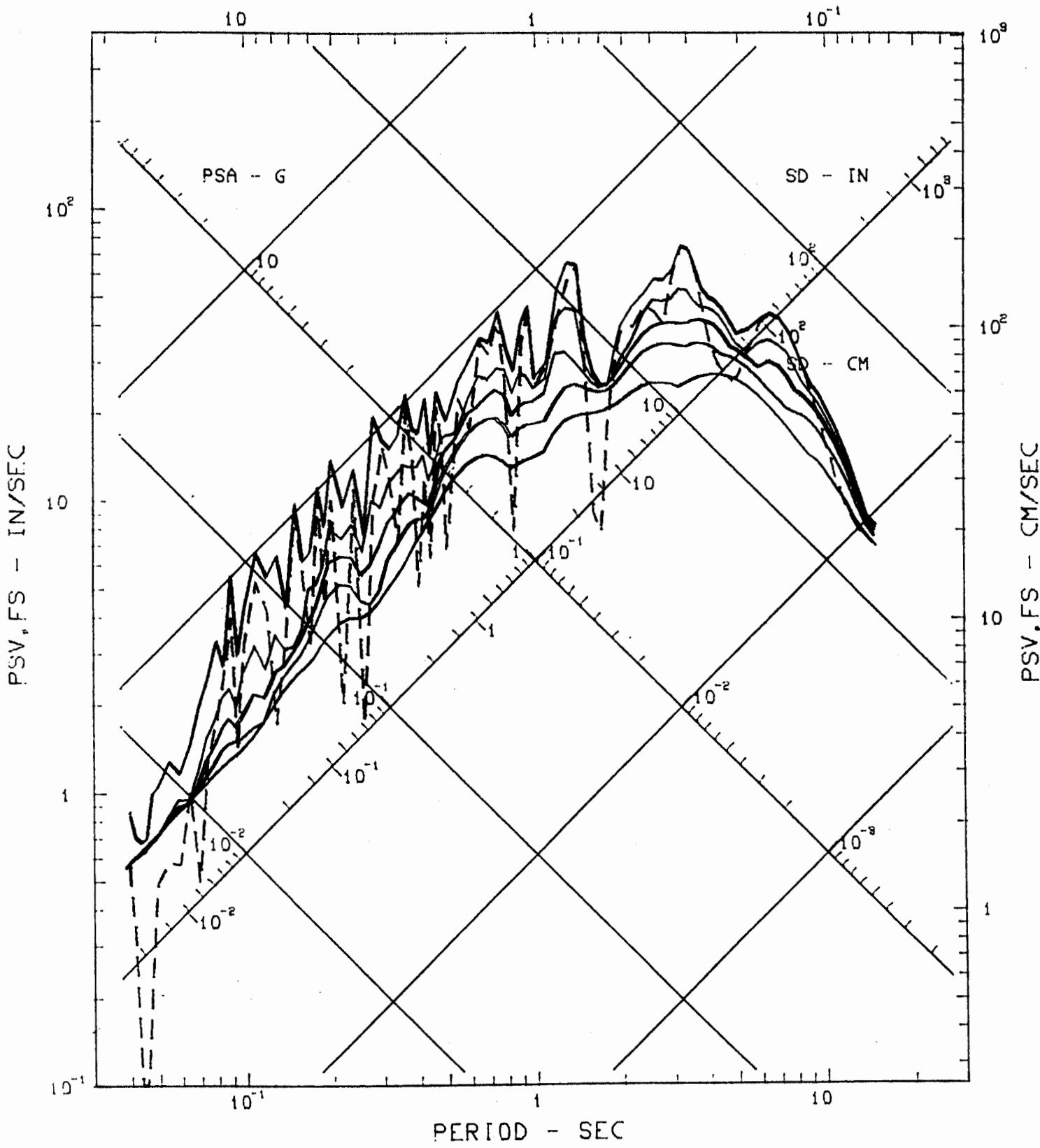
RESPONSE AND FOURIER SPECTRA

IMPERIAL VALLEY EARTHQUAKE, EL CENTRO, CAL. OCT 15, 1979 -1616 PDT

III A002 79.002.0 EL CENTRO CO CENTER FF, EL CENTRO, CALIFORNIA COMP N92E
 ACCELEROGRAM IS BAND-PASS FILTERED BETWEEN 0.050-0.070 AND 25.00-27.00 CYC/SEC.
 DAMPING VALUES ARE 0, 2, 5, 10 & 20 % OF CRITICAL

— RESPONSE SPECTRA: PSV, PSA & SD —— FOURIER AMPLITUDE SPECTRUM: FS

FREQUENCY - Hz



RESPONSE AND FOURIER SPECTRA

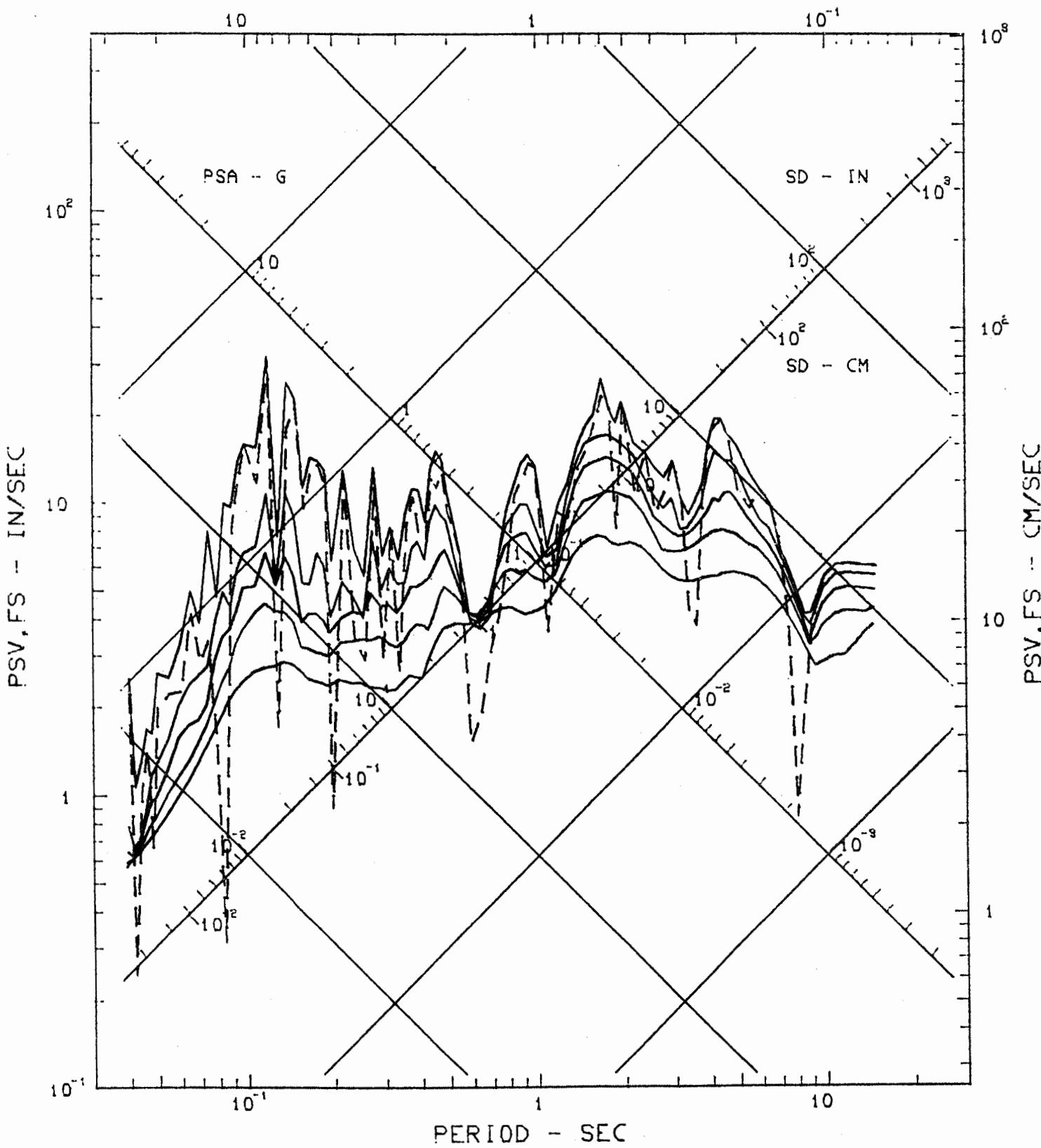
15

IMPERIAL VALLEY EARTHQUAKE, EL CENTRO, CAL. OCT 15, 1979 -1616 PDT

III A002 79.002.0 EL CENTRO CO CENTER FF, EL CENTRO, CALIFORNIA COMP UP
ACCELEROGRAM IS BAND-PASS FILTERED BETWEEN 0.050-0.070 AND 25.00-27.00 CYC/SEC.
DAMPING VALUES ARE 0, 2, 5, 10 & 20 % OF CRITICAL

— RESPONSE SPECTRA: PSV, PSA & SD - - - FOURIER AMPLITUDE SPECTRUM: FS

FREQUENCY - HZ

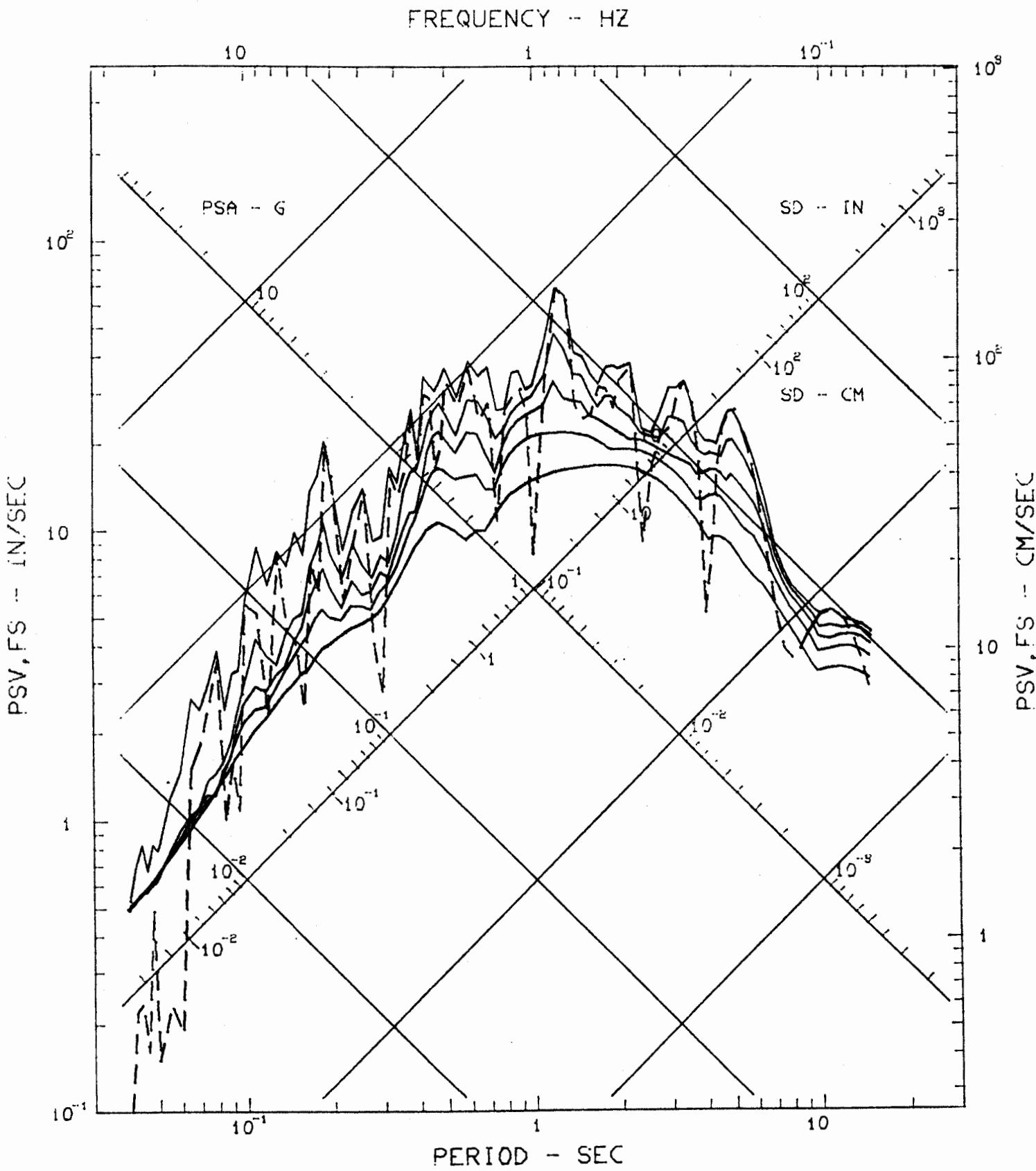


RESPONSE AND FOURIER SPECTRA

IMPERIAL VALLEY EARTHQUAKE, EL CENTRO, CAL. OCT 15, 1979 -1616 PDT

III A002 79.002.0 EL CENTRO CO CENTER FF, EL CENTRO, CALIFORNIA COMP N02E
 ACCELEROGRAM IS BAND-PASS FILTERED BETWEEN 0.050-0.070 AND 25.00-27.00 CYC/SEC.
 DAMPING VALUES ARE 0, 2, 5, 10 & 20 % OF CRITICAL

— RESPONSE SPECTRA: PSV, PSA & SD —— FOURIER AMPLITUDE SPECTRUM: FS



STRONG-MOTION RECORD DATA

STATION DATA

Name Westmorland (Temp) Owner CDMG
 Address 230 W. Main St.
Westmorland, CA. 92281
 County Imperial
 Number: CDMG -- USGS --
 Coordinates: Latitude 33.037 °N; Longitude 115.623 °W
 Instrument(s)

Type (traces)	Serial Number	Date Installed	Date Removed
SMA-1T (3)	2588	11-5-76	--

EARTHQUAKE DATA

Name (Region) Imperial Valley earthquake
 Date 15 October 1979 Epicentral Distance: 52.0 km

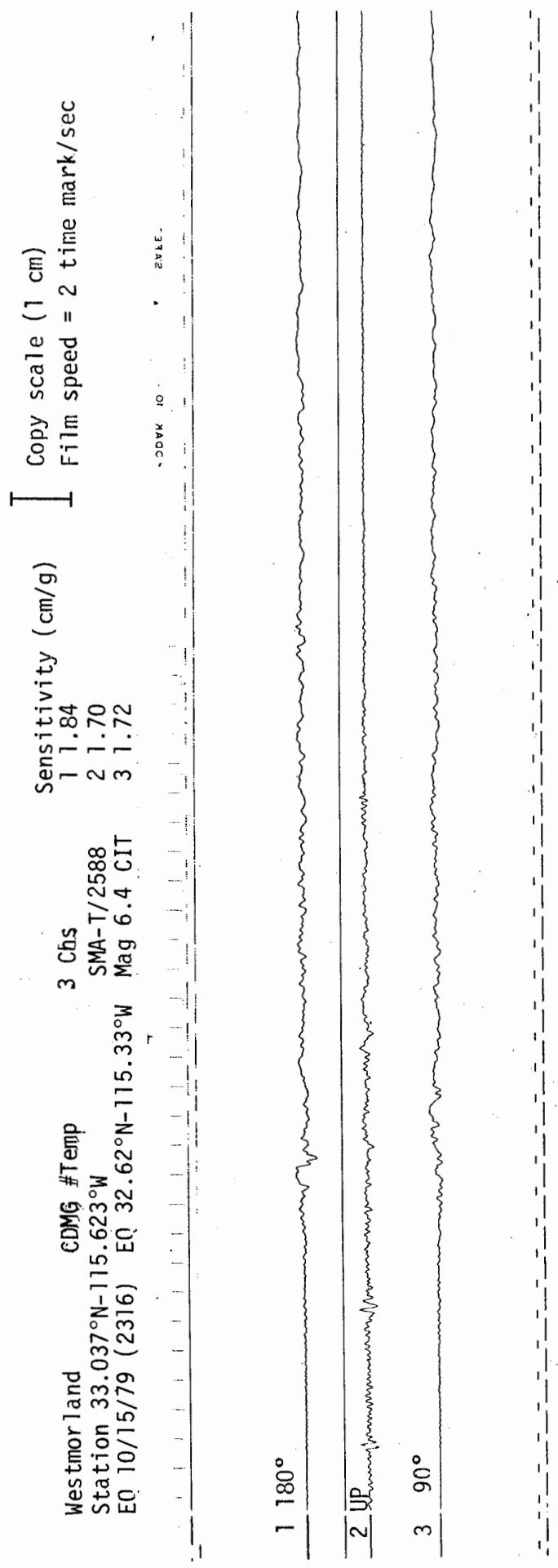
SITE GEOLOGY

Site underlain by Quaternary lake bed deposits that are intercalated with alluvial fill of Salton Trough.

TRACE EVALUATION/DATA

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% Crit)	Peak Acc. (% g)
1	180	18.4	25.5	57.2	10.6
2	UP	17.0	25.5	59.1	8.5
3	90	17.2	25.5	60.0	8.1

Structural orientation reference: North = n/a °



STRONG-MOTION RECORD DATA

STATION DATA

Name Niland Owner CDMG
 Address 8071 Luxor Street
Niland, CA. 92257
 County Imperial
 Number: CDMG 23 USGS 724
 Coordinates: Latitude 33.239 °N; Longitude 115.512 °W
 Instrument(s)

Type (traces)	Serial Number	Date Installed	Date Removed
SMA-1T (3)	2550	5-3-73	-

EARTHQUAKE DATA

Name (Region) Imperial Valley earthquake
 Date 15 October 1979 Epicentral Distance: 68.6 km

SITE GEOLOGY

Site underlain by Quaternary lake bed deposits that are intercalated with alluvial fill of Salton Trough.

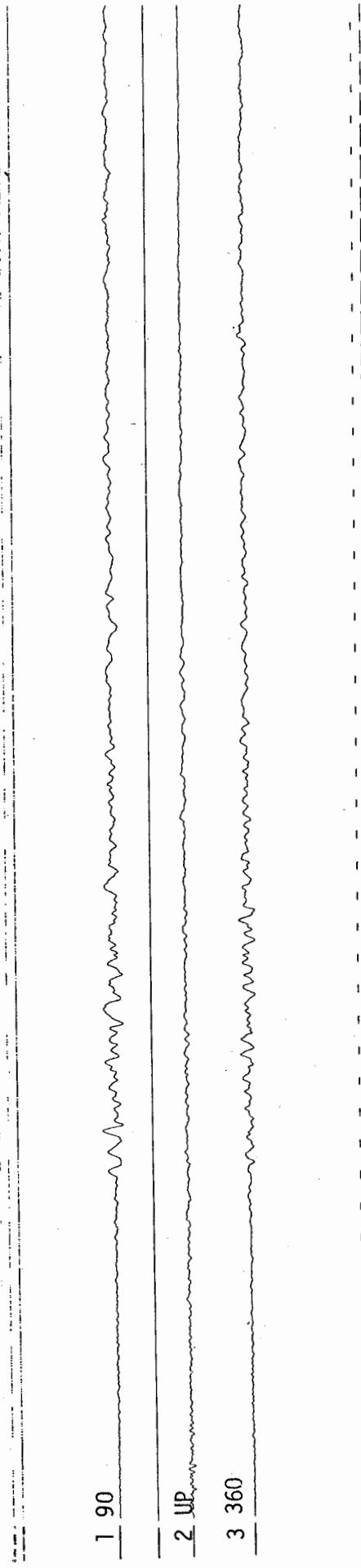
TRACE EVALUATION/DATA

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% Crit)	Peak Acc. (% g)
1	90	17.5	26.7	55.9	10.0
2	UP	17.6	26.4	56.5	2.8
3	360	18.9	25.8	57.5	7.4

Structural orientation reference: North = n/a °

Niland Fire Station CDMG #23
Station 33.239°N-115.512°W
EQ 32.62°N-115.33°W
EO 10/15/79 (2316)

Sensitivities (cm/g) Copy Scale (1 cm)
3 Chs Film speed = 2 time mark/sec
SMA-T/2550 1 1.75
Mag 6.4 CIT 2 1.76
 3 1.89



STRONG-MOTION RECORD DATA

STATION DATA

Name Winterhaven Owner CDMG
 Address 2124 Winterhaven Dr.
Winterhaven, CA.
 County Imperial
 Number: CDMG 22 USGS 723
 Coordinates: Latitude 32.74 °N; Longitude 114.64 °W
 Instrument(s)

Type (traces)	Serial Number	Date Installed	Date Removed
RFT-250 (3)	<u>441</u>	<u>5-2-73</u>	<u>-</u>

EARTHQUAKE DATA

Name (Region) Imperial Valley earthquake
 Date 15 October 1979 Epicentral Distance: 65.7 km

SITE GEOLOGY

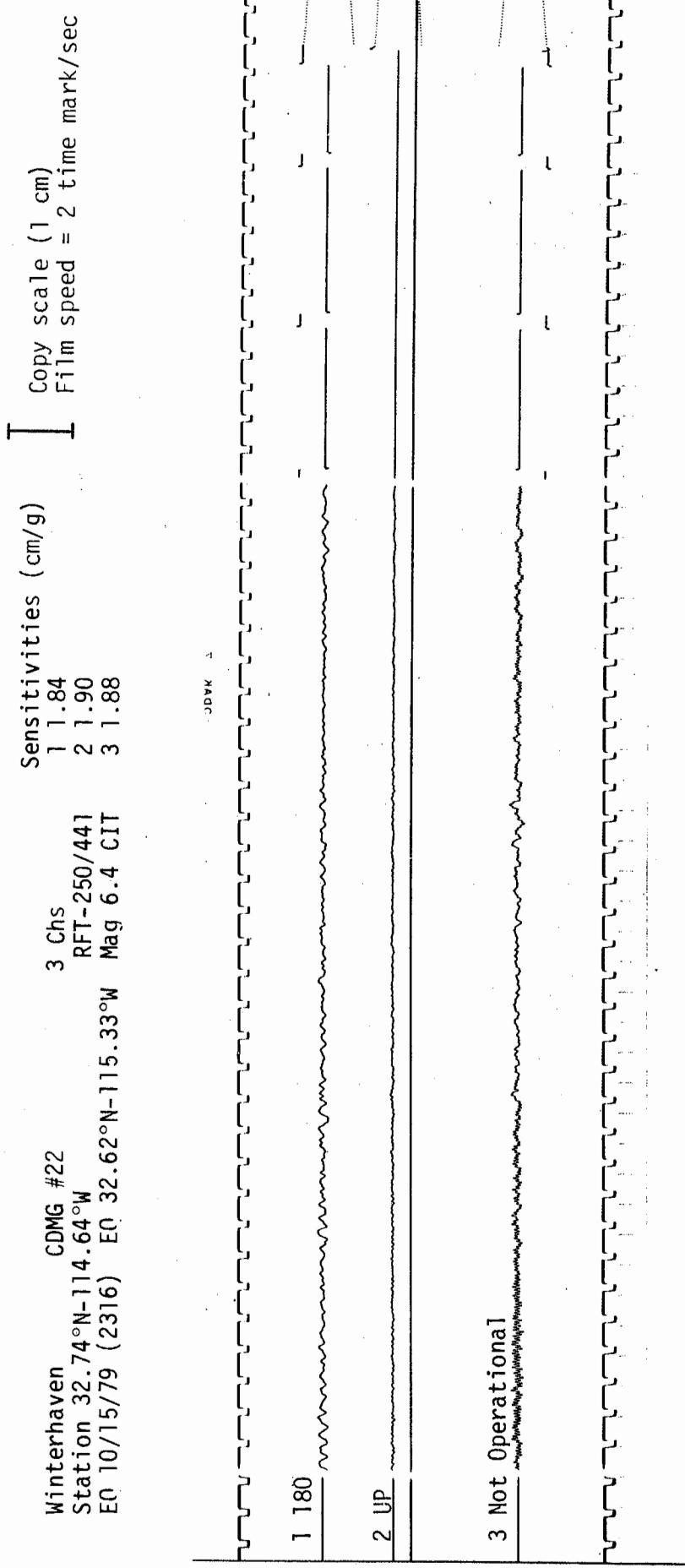
Site underlain by alluvium deposited by Colorado River; alluvial depth is uncertain but probably exceeds 40 m.

TRACE EVALUATION/DATA

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% Crit)	Peak Acc. (% g)
1	180	18.4	21.9	41	5.4
2	UP	19.0	21.6	44	1.8
3	90	18.8	21.6	42	non-op.

Structural orientation reference: North = n/a °

Winterhaven CDMG #22
Station 32.74°N-114.64°W
En 10/15/79 (2316) Eo 32.62°N-115.33°W



Structural Response Data

Records obtained from instruments located in structures are briefly summarized in Table III. For each structure, the Table lists the station location, coordinates, site geology, structure type and size, and instrument locations. Where significant records were obtained, additional data are provided, including the structure description, instrumentation scheme, record evaluation and a copy of significant portions of the film record. Processed data are included only for the Imperial County Services Building.

El Centro-County Services Building

The most significant record of the 15 October earthquake was obtained from the six-story reinforced concrete Imperial County Services Building. This structure was heavily damaged during the earthquake. The building is instrumented with a central recording system that recorded motion at 13 accelerometers located as noted on the instrumentation scheme. Accelerometer locations for a 9 channel system were initially selected by a subcommittee of the Structural Engineers Association of Southern California. This station was later upgraded to 13 channels by Chris Rojahn of the USGS. The system was installed and is maintained by OSMS. A triaxial freefield accelerograph on a 1.2 m x 1.2 m concrete pad recorded motion on the ground 100 m east of the building. Both recorders are equipped with radio time. Peak accelerations at the roof were 0.59 g in the north direction and 0.48 g in the east direction. On the ground floor, peak accelerations were 0.35 g in the north direction and 0.32 g in the east direction. Peak accelerations on all traces are noted on the record data sheets.

The first 23 seconds of the building record was digitized and processed at USC using automated digitizing equipment and standard routine processing methods (Trifunac and Lee, 1973). Corrected accelerations, velocities and displacements are presented for all building traces and response spectra are presented for ground level building traces. Digitization and processing of the full-length record is currently being completed.

Earthquake records from this structure should be very useful in evaluating building motions and force levels that led to the extensive structural damage. Comparison of the ground level building record with the freefield record should provide excellent data for studying interaction between structure and supporting soil.

The building and earthquake records are the subject of several research proposals to the National Science Foundation by which response of theoretical building models may be compared with the recorded response. It is expected that these studies will lead to an improved understanding of the response of concrete buildings to strong-motion and in turn to improve building code requirements for this type of structure.

E1 Centro-Route 8/Meloland Overpass

Twenty-six traces of acceleration data were obtained from a two-span reinforced-concrete box-girder freeway-overpass structure. Peak horizontal accelerations on the structure were 0.39 g in the north direction and 0.52 g in the west direction. Peak horizontal accelerations at the ground level freefield 60 m west of the overpass were 0.32 g in the north direction and 0.30 g in the west direction. Although the overpass structure was not damaged by earthquake motion, the records should be very useful in evaluating the response of this type of bridge structure to strong ground motion.

TABLE III

Structural response and station data for CDMG instrumented structures that recorded the Imperial Valley earthquake.

No.	Station Name	Coord.	Structure type/size	Instrument location(s)	Remarks
243	E1 Capitan Dam	32.88°N 116.82°W	earth dam	abutment L & C crest	small amplitude
260	E1 Centro Co Services Bldg.	32.79°N 115.56°W	6-story bldg	ground level 2nd,4th,roof	0.59 g roof 0.35 g grnd
336	E1 Centro Rt 8/Meloland Overpass	32.77°N 115.45°W	Frwy overpass	ground level abutments, deck	0.52 g deck 0.32 g grnd
284	Palm Desert Kiewit Bldg	33.76°N 116.54°W	4-story bldg	ground level 2nd, roof	small amplitude
299	Palm Springs Desert Hospital	33.84°N 116.51°W	4-story bldg	ground level 2nd, roof	small amplitude
312	Riverside City Admin Bldg	33.98°N 117.37°W	13-story bldg	basement,3rd 7th, roof	small amplitude
300	San Diego Gas & Elect Bldg	32.72°N 117.16°W	22-story bldg	basement,3rd 12th,20th, roof	small amplitude

INSTRUMENTED BUILDING DESCRIPTION FORM

Building: Imperial County Services Building
 Address: 940 Main Street
 El Centro, California

Coordinates: 32.79° °N 115.56° °W

Number of stories above/below ground: 6 / 0

Plan Shape: Rectangular

Base dimension: 136'-10" x 85'-4"

Typical floor plan dimensions: Same as base dimensions

Vertical load carrying system: 5" rc slabs supported by rc pan joists
 (include floor decking system:
 spanning in transverse direction: joists
 supported by rc frame)

Lateral force resisting system: RC shear-walls in transverse direction;
 (include element locations)
 rc frame in longitudinal direction.

Foundation type: Raymond step-taper piles under each column; pile
 caps inter-connected with rc tie beams

Unusual architectural features: shear-walls discontinuous at second floor level

Design data: 1968 Construction date: 1971

Design engineer: Bryant, Jehle & Assoc.

Firm name: 444 S. Eighth Street

Address: P.O. Box 782
 El Centro, CA 92243 714/352-6651

Architect: Same as design engineer

Firm name:

Address:

Owner's Representative: Gene Bennings, Director of Buildings & Grounds

Building name: Imperial County Services Building

Address: c/o County Courthouse, Main Street
 El Centro, CA 714/352-3610, ext. 260

Remarks:

STRONG-MOTION RECORD DATA

STATION DATAName E1 Centro-County Services Bldg. Owner CDMGAddress 940 Main StreetE1 Centro, Ca. 92243County ImperialNumber: CDMG 260 USGS -Coordinates: Latitude 32.793 °N; Longitude 115.564 °W

Instrument(s)

Type (traces)	Serial Number	Date Installed	Date Removed
<u>CR-1 (13)</u>	<u>125</u>	<u>5/14/76; 4/1/78</u>	<u>-</u>

EARTHQUAKE DATAName (Region) Imperial Valley earthquakeDate 15 October 1979 Epicentral Distance: 27.2 kmSITE GEOLOGY

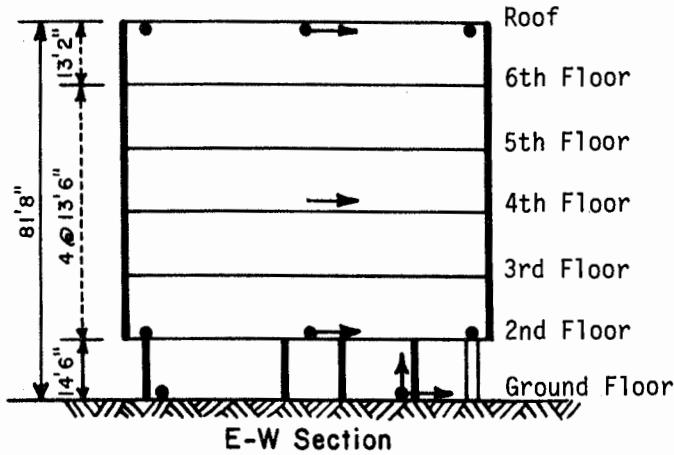
Site underlain by Quaternary lake bed deposits that are intercalated with alluvial fill of Salton Trough. Perpendicular distance to Imperial fault is 7 km.

TRACE EVALUATION/DATA

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% Crit)	Peak Acc. (% g)
1	N	18.2	52.8	66	55.7
2	N	18.4	53.6	65	56.5
3	N	17.4	53.2	63	58.8
4	E	18.4	52.9	64	48.1
5	E	17.1	50.8	63	26.0
6	E	18.2	52.1	61	29.1
7	N	18.6	54.8	65	35.8
8	N	18.2	54.2	64	31.9
9	N	17.2	51.8	64	36.3
10	N	17.4	53.0	64	34.7
11	N	18.4	54.5	67	29.1
12	UP	18.3	51.5	66	18.6
13	E	18.5	54.0	67	31.9

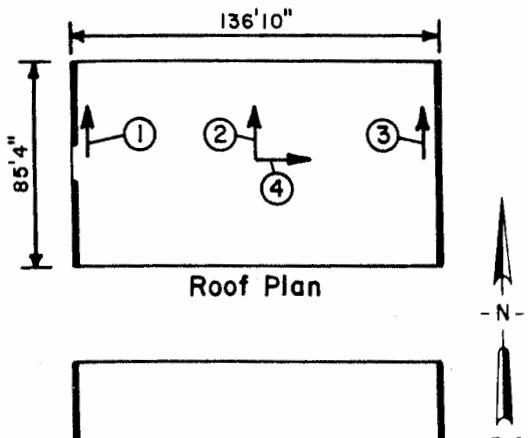
Structural orientation reference: North = 360 °

IMPERIAL VALLEY EARTHQUAKE
15 OCTOBER 1979
EL CENTRO COUNTY SERVICES BUILDING
STRONG-MOTION INSTRUMENTATION SCHEME



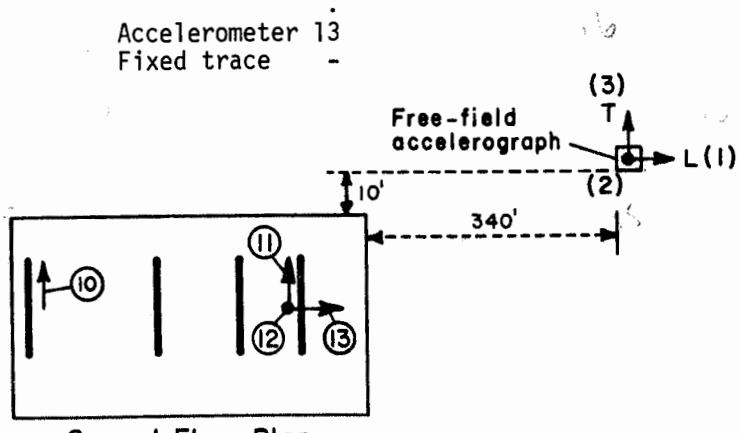
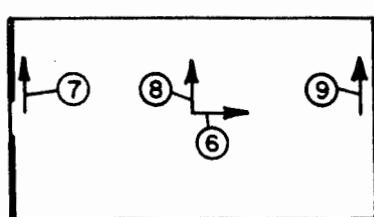
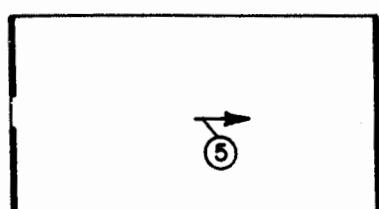
INSTALLATION NOTES:

Accelerometers 1 through 4 attached to underside of roof slab; accelerometers 5 through 13 attached to topside of slabs. Horizontal starter adjacent and parallel to accelerometer 4. Vertical starter adjacent to triaxial package on ground floor.



RECORDER TRACE ORDER:

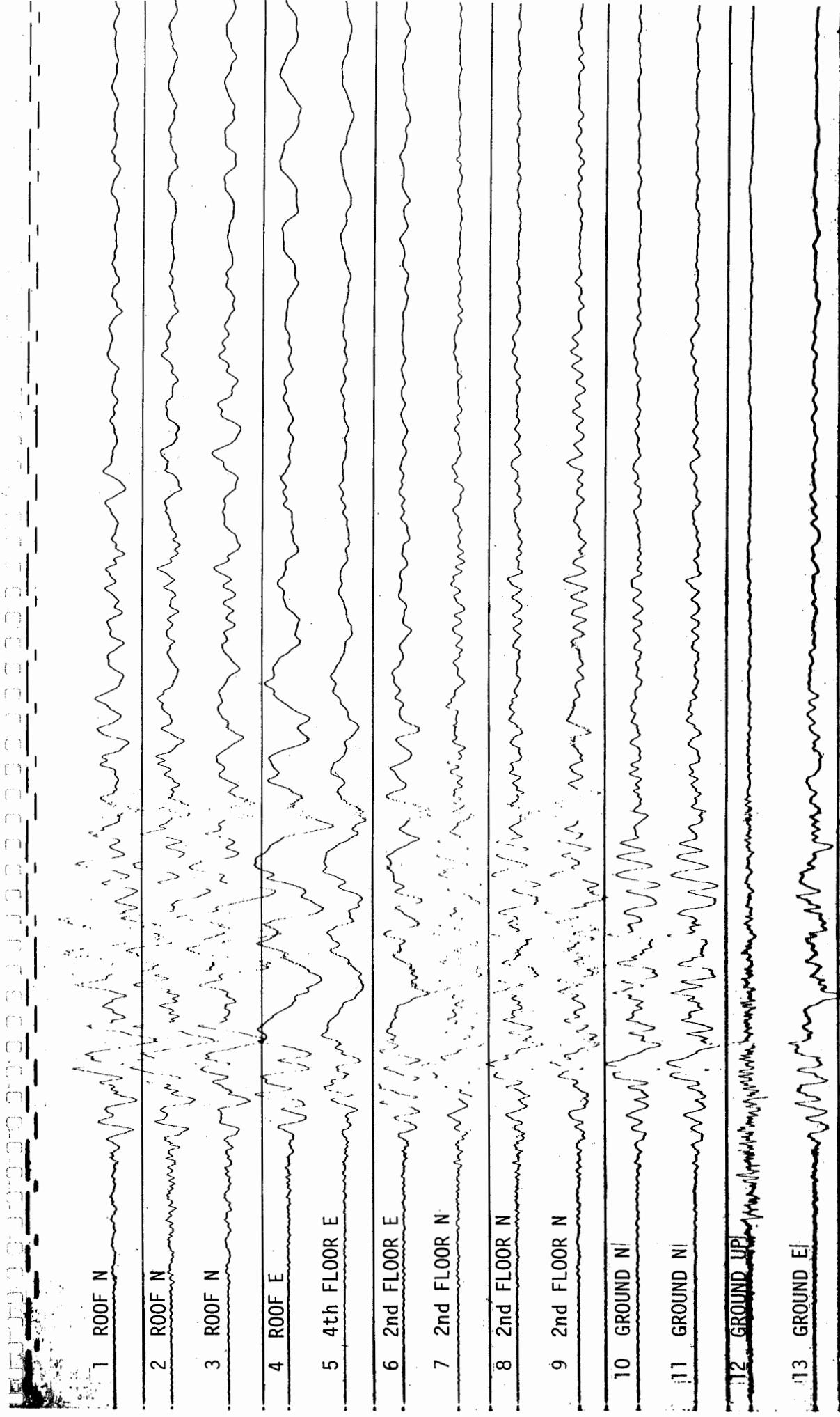
Accelerometer 1	1
Fixed trace	-
Accelerometer 2	2
Accelerometer 3	3
Fixed Trace	-
Accelerometer 4	4
Accelerometer 5	5
Fixed trace	-
Accelerometer 6	6
.	.
Accelerometer 13	13
Fixed trace	-



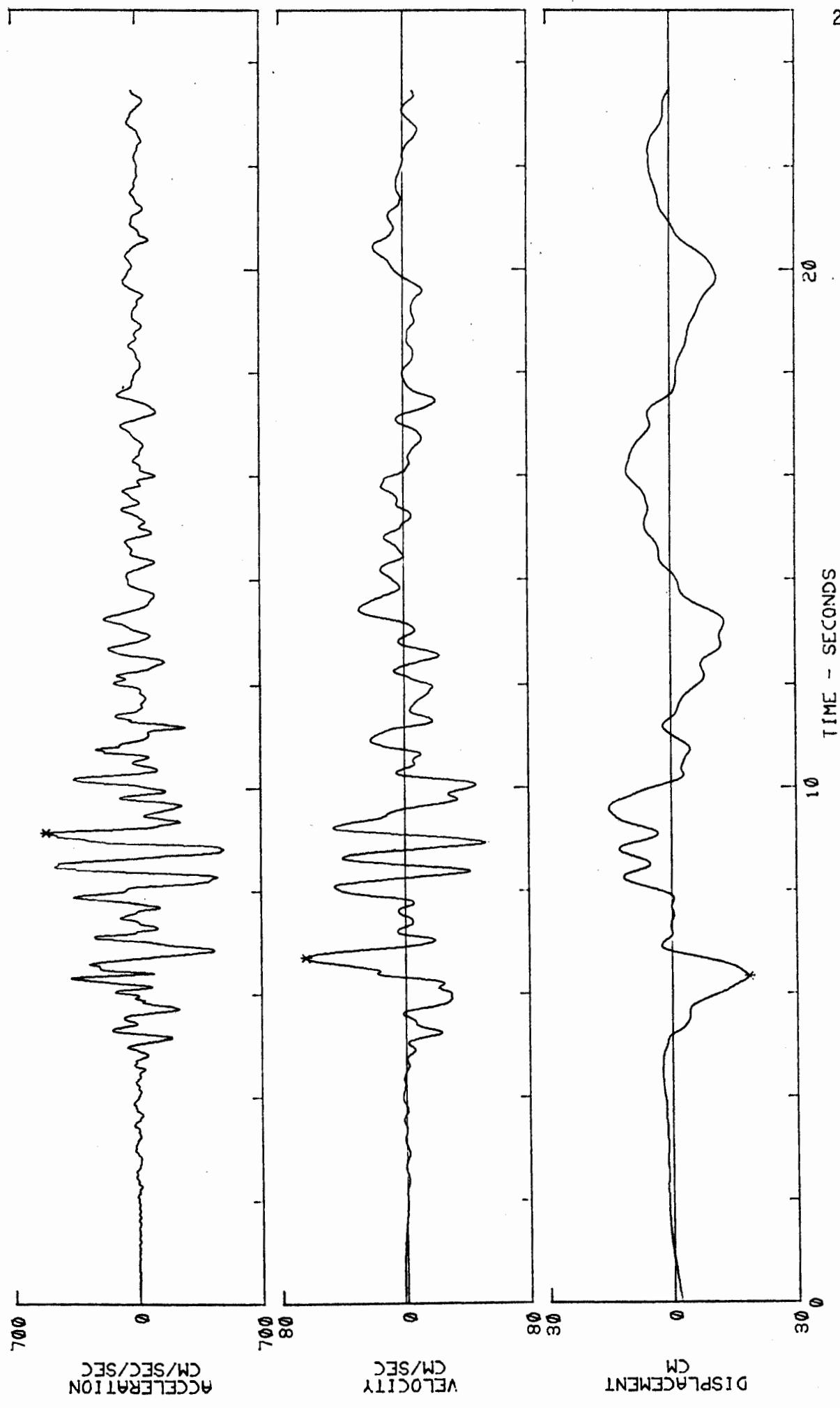
EL CENTRO / IMPERIAL COUNTY SERVICES BLDG CDMG #260 13Chs.
STATION 32.793°N-115.564°W
EQ 10/15/79 EQ 32.62°N-115.33°W

CR-1/125
MAG 6.6 (CIT)

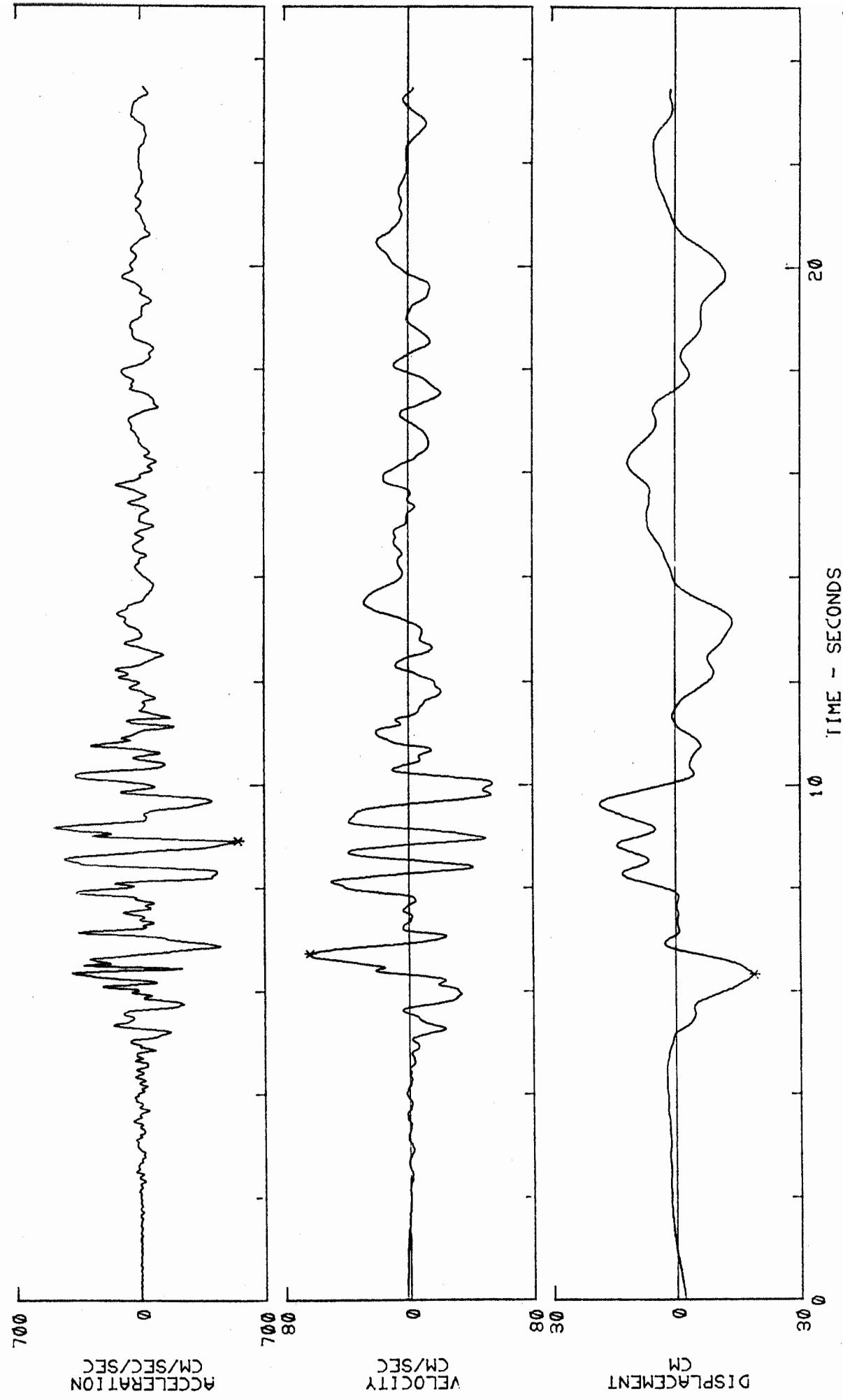
Copy Scale (1cm)
Film Speed = 2 time mark/sec



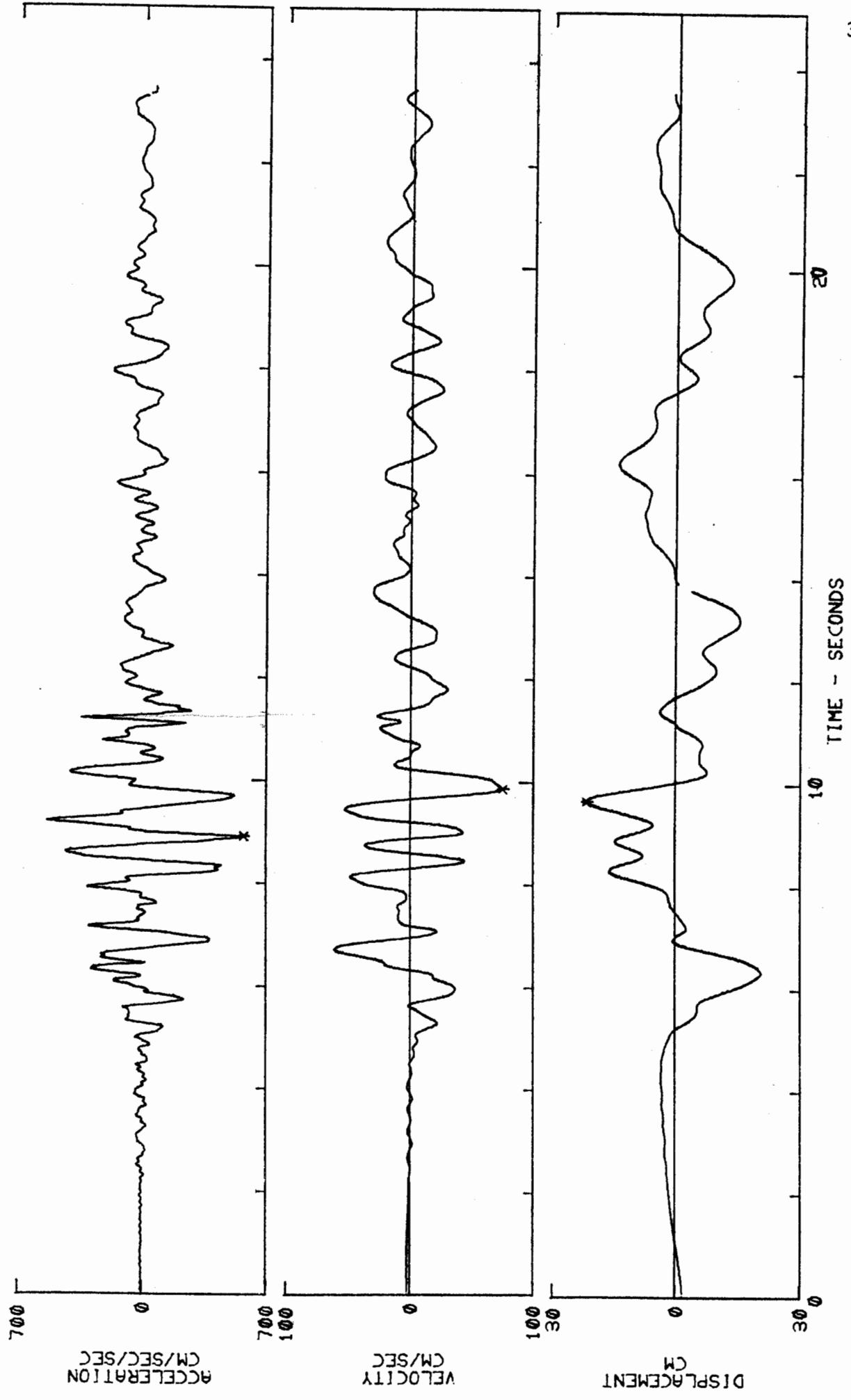
IMPERIAL VALLEY EARTHQUAKE, EL CENTRO, CAL. OCT 15, 1979 -1616 PDT
11A001 79.001.0 IMPERIAL COUNTY SERVICE BLDG., ROOF L, EL CENTRO, CALIFORNIA TRACE 1
ACCELEROMETER IS BAND-PASS FILTERED BETWEEN 0.095-0.125 AND 25.00-27.00 CYC/SEC.
*PEAK VALUES : ACCELERATION = -519.4 CM/SEC/SEC VELOCITY = -64.2 CM/SEC DISPLACEMENT = 18.5 CM



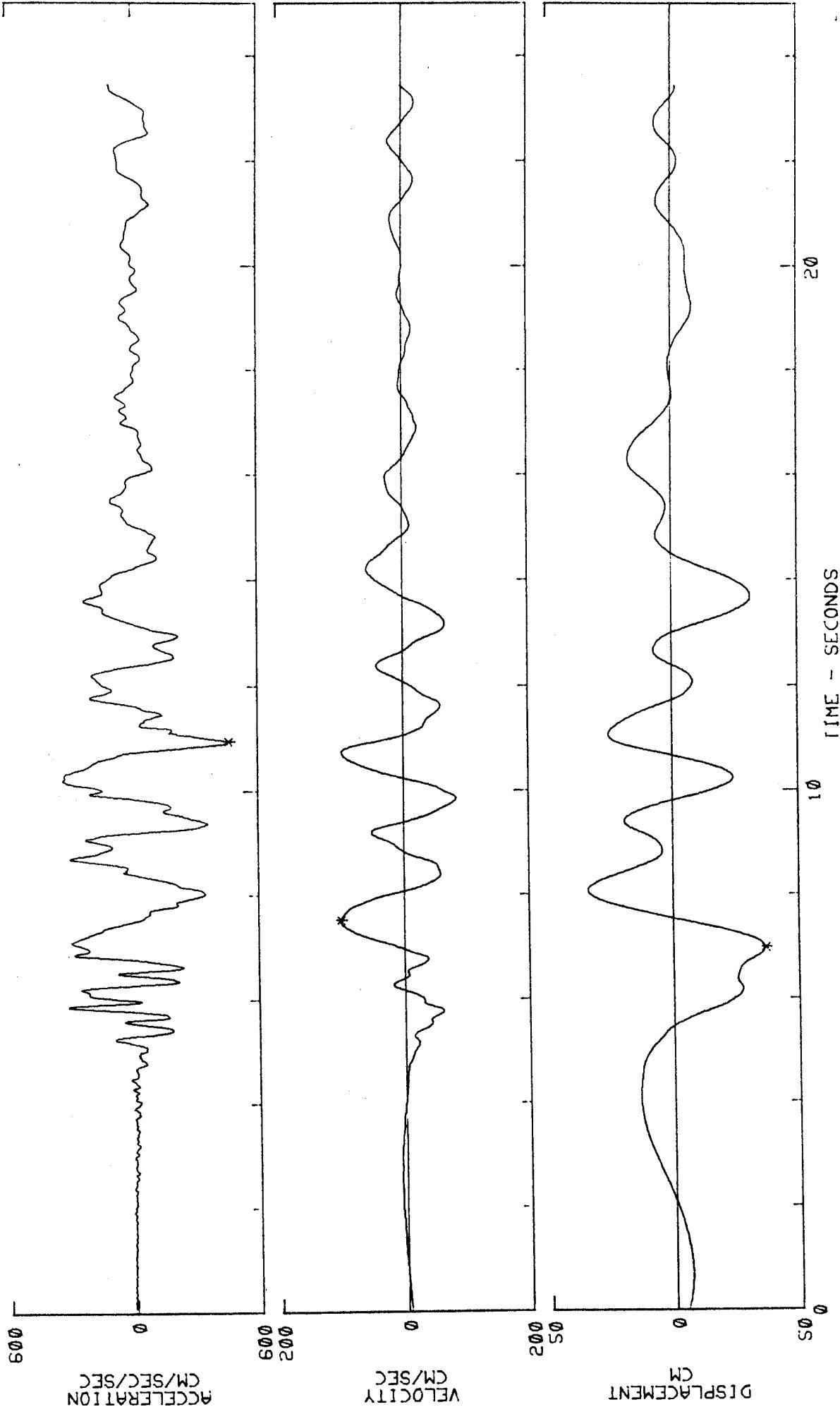
IMPERIAL VALLEY EARTHQUAKE, EL CENTRO, CAL. OCT 15, 1979 -1616 PDT
11A001 79.001.0 IMPERIAL COUNTY SERVICE BLDG., ROOF C, EL CENTRO, CALIFORNIA TRACE 2
ACCELEROMGRAM IS BAND-PASS FILTERED BETWEEN 0.095-0.125 AND 25.00-27.00 CYC/SEC.
*PEAK VALUES : ACCELERATION = 549.1 CM/SEC/SEC VELOCITY = -63.9 CM/SEC DISPLACEMENT = 18.7 CM

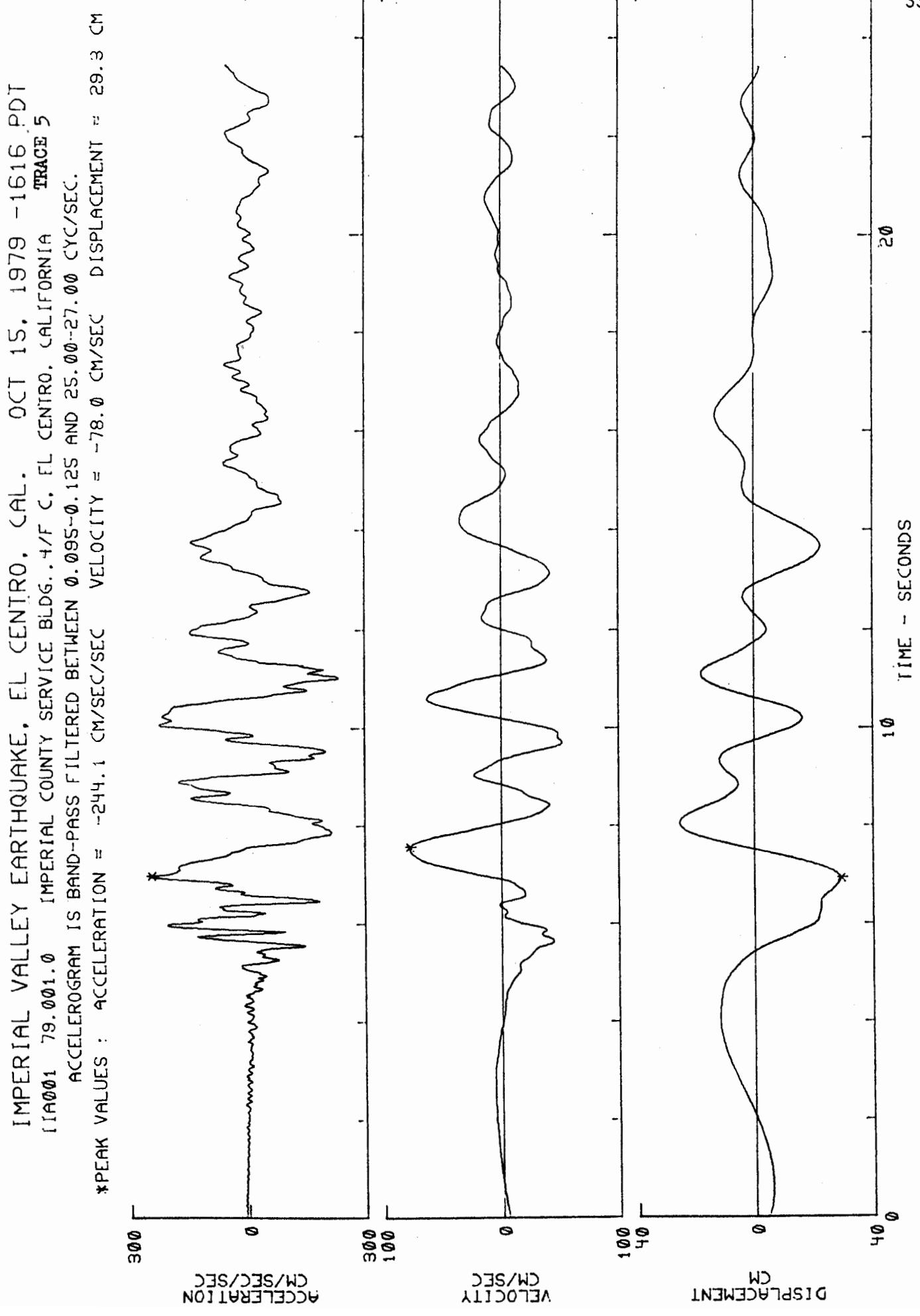


IMPERIAL VALLEY EARTHQUAKE, EL CENTRO, CAL. OCT 15, 1979 -1616 PDT
IIA001 79.001.0 IMPERIAL COUNTY SERVICE BLDG., ROOF R. EL CENTRO, CALIFORNIA TRACE 3
ACCELEROMGRAM IS BAND-PASS FILTERED BETWEEN 0.095-0.125 AND 25.00-27.00 CYC/SEC.
*PEAK VALUES : ACCELERATION = 571.0 CM/SEC/SEC VELOCITY = 75.0 CM/SEC DISPLACEMENT = -21.5 CM

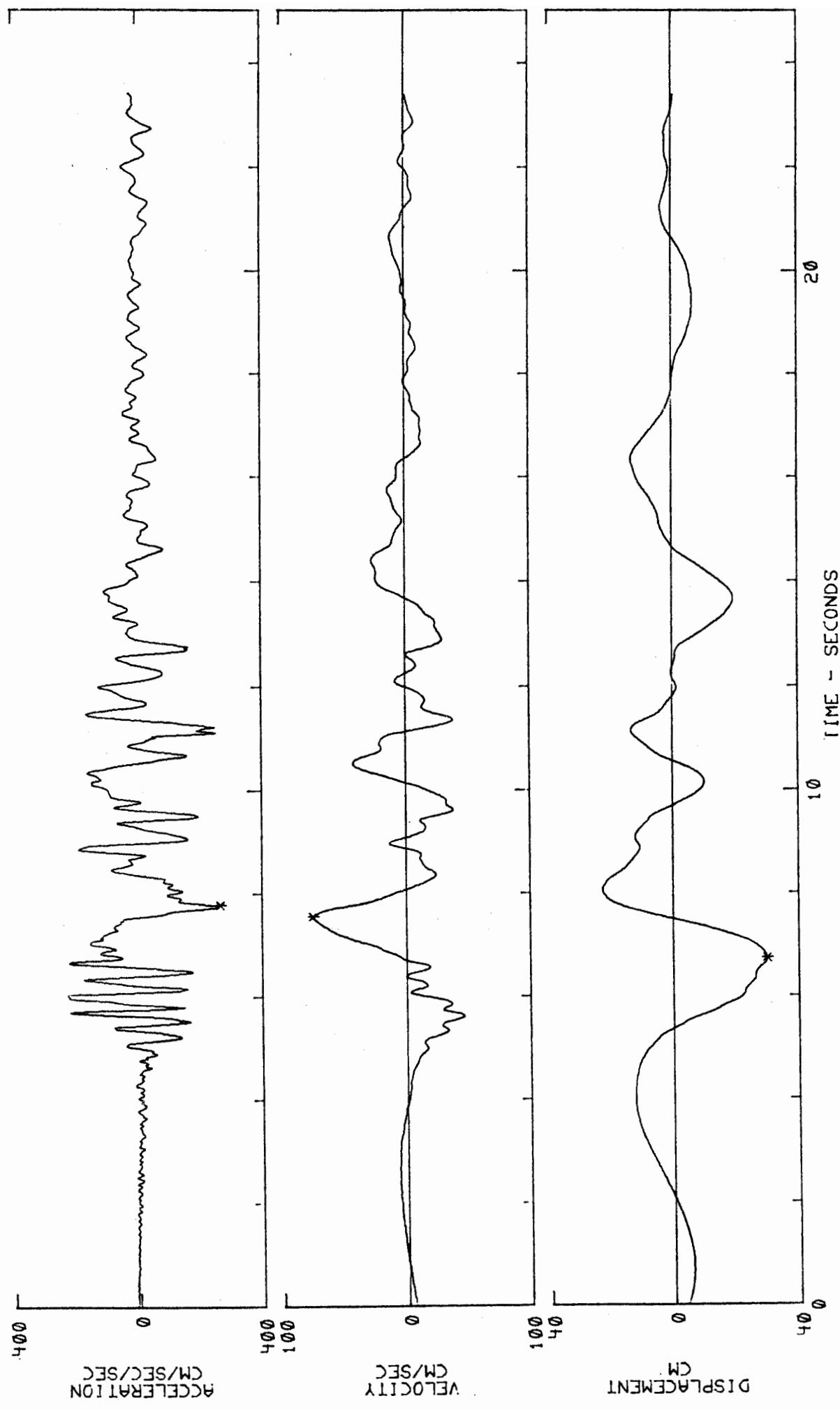


IMPERIAL VALLEY EARTHQUAKE, EL CENTRO, CAL. OCT 15, 1979 - 1616 PDT
RA001 79.001.0 IMPERIAL COUNTY SERVICE BLDG., ROOF C, FL CENTRO, CALIFORNIA TRACE 4
ACCELEROMETER IS BAND-PASS FILTERED BETWEEN 0.095-0.125 AND 25.00-27.00 CYC/SEC.
*PEAK VALUES : ACCELERATION = 461.8 CM/SEC/SEC VELOCITY = -101. CM/SEC DISPLACEMENT = 36.6 CM

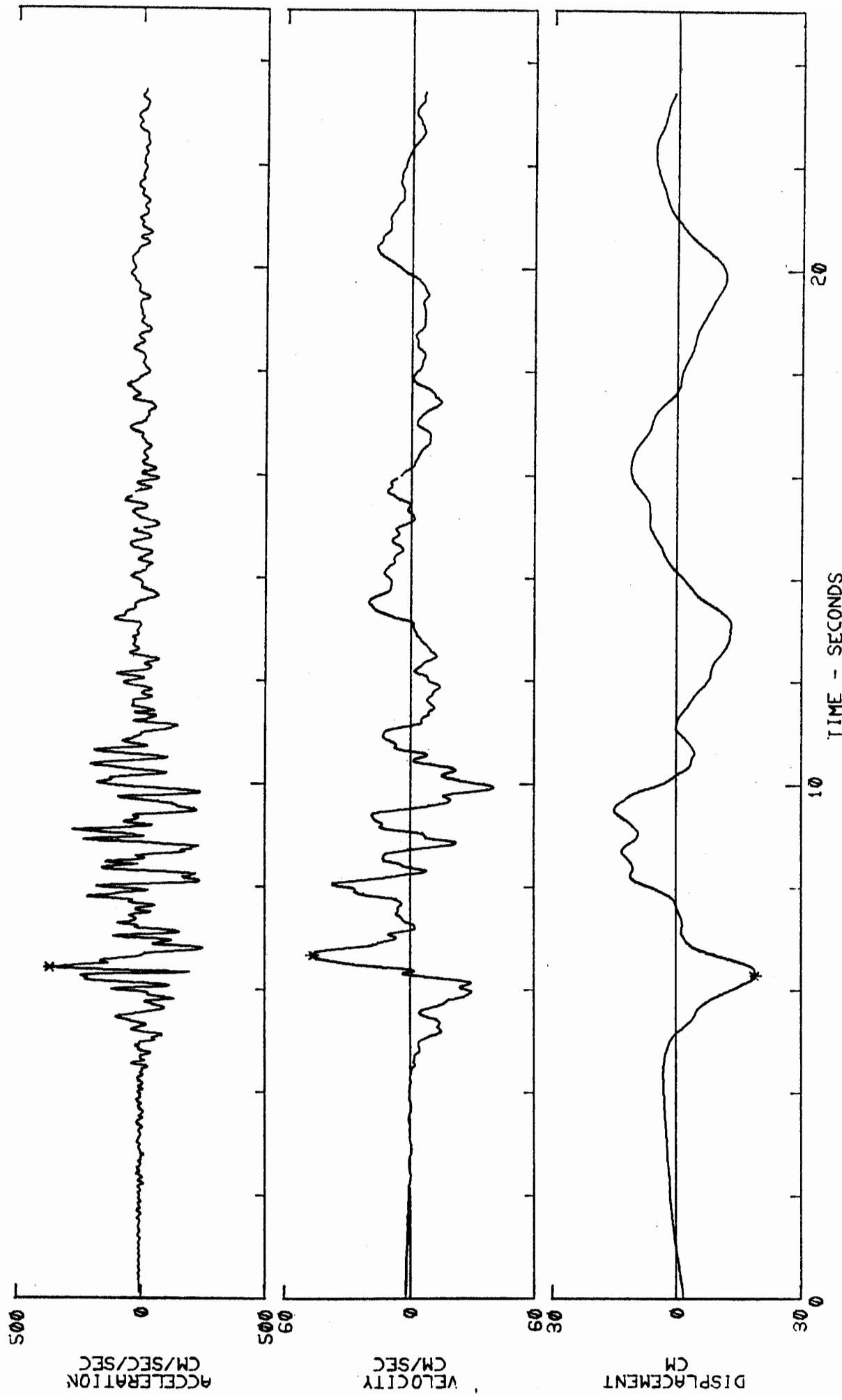




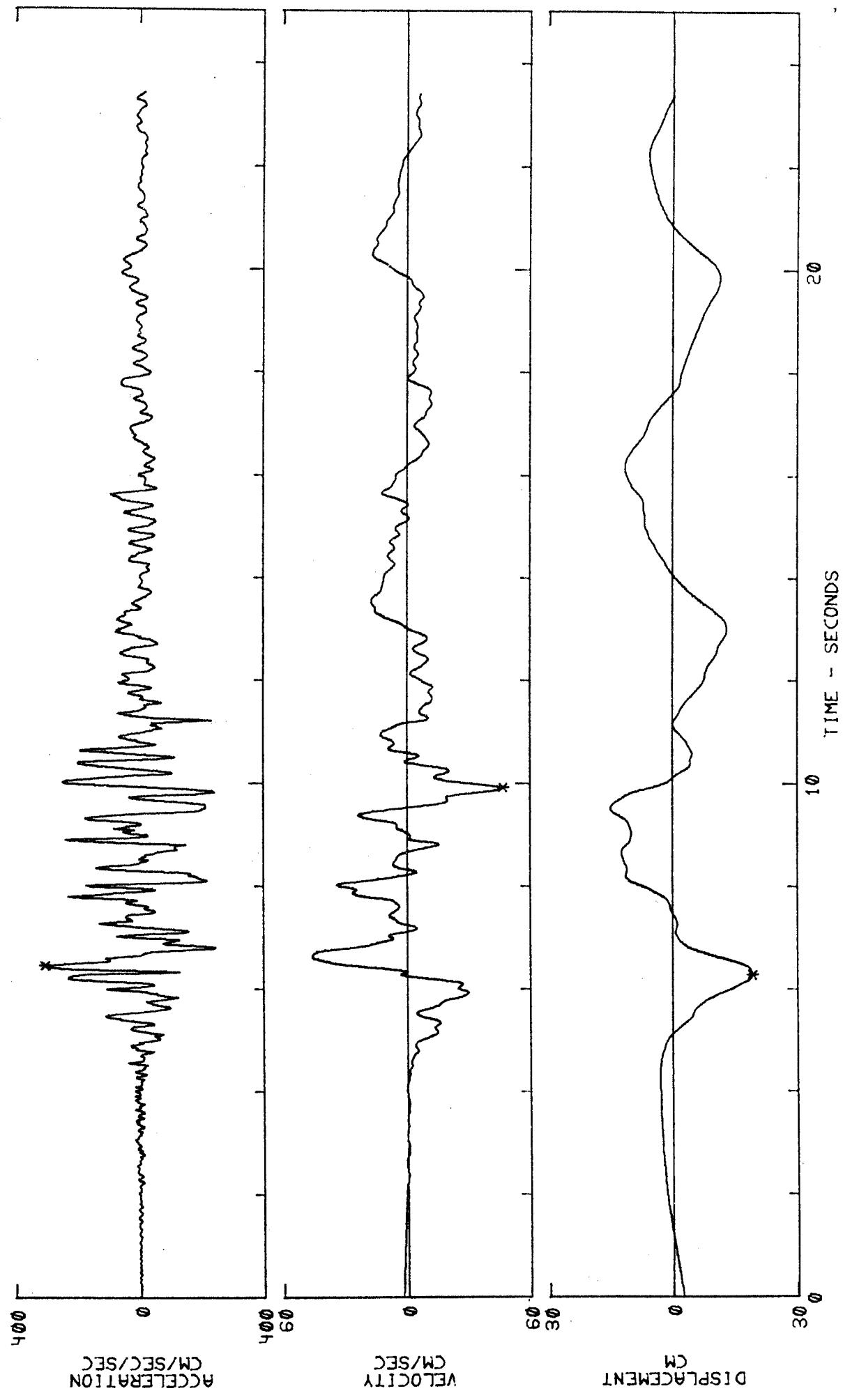
IMPERIAL VALLEY EARTHQUAKE, EL CENTRO, CAL. OCT 15, 1979 - 1616 PDT
 STA#01 79.001.0 IMPERIAL COUNTY SERVICE BLDG., 2/F C. EL CENTRO, CALIFORNIA TRACE 6
 ACCELEROMETER IS BAND-PASS FILTERED BETWEEN 0.095-0.125 AND 25.00-27.00 CYC/SEC.
 *PEAK VALUES : ACCELERATION = 263.0 CM/SEC/SEC VELOCITY = -75.4 CM/SEC DISPLACEMENT = 28.9 CM



IMPERIAL VALLEY EARTHQUAKE, EL CENTRO, CAL. OCT 15, 1979 - 1616 PDT
IIA001 79.001.0 IMPERIAL COUNTY SERVICE BLDG., 2/F L. EL CENTRO, CALIFORNIA TRACE 7
ACCELEROMGRAM IS BAND-PASS FILTERED BETWEEN 0.095-0.125 AND 25.00-27.00 CYC/SEC.
*PEAK VALUES : ACCELERATION = -367.7 CM/SEC/SEC VELOCITY = -46.6 CM/SEC DISPLACEMENT = 19.2 CM



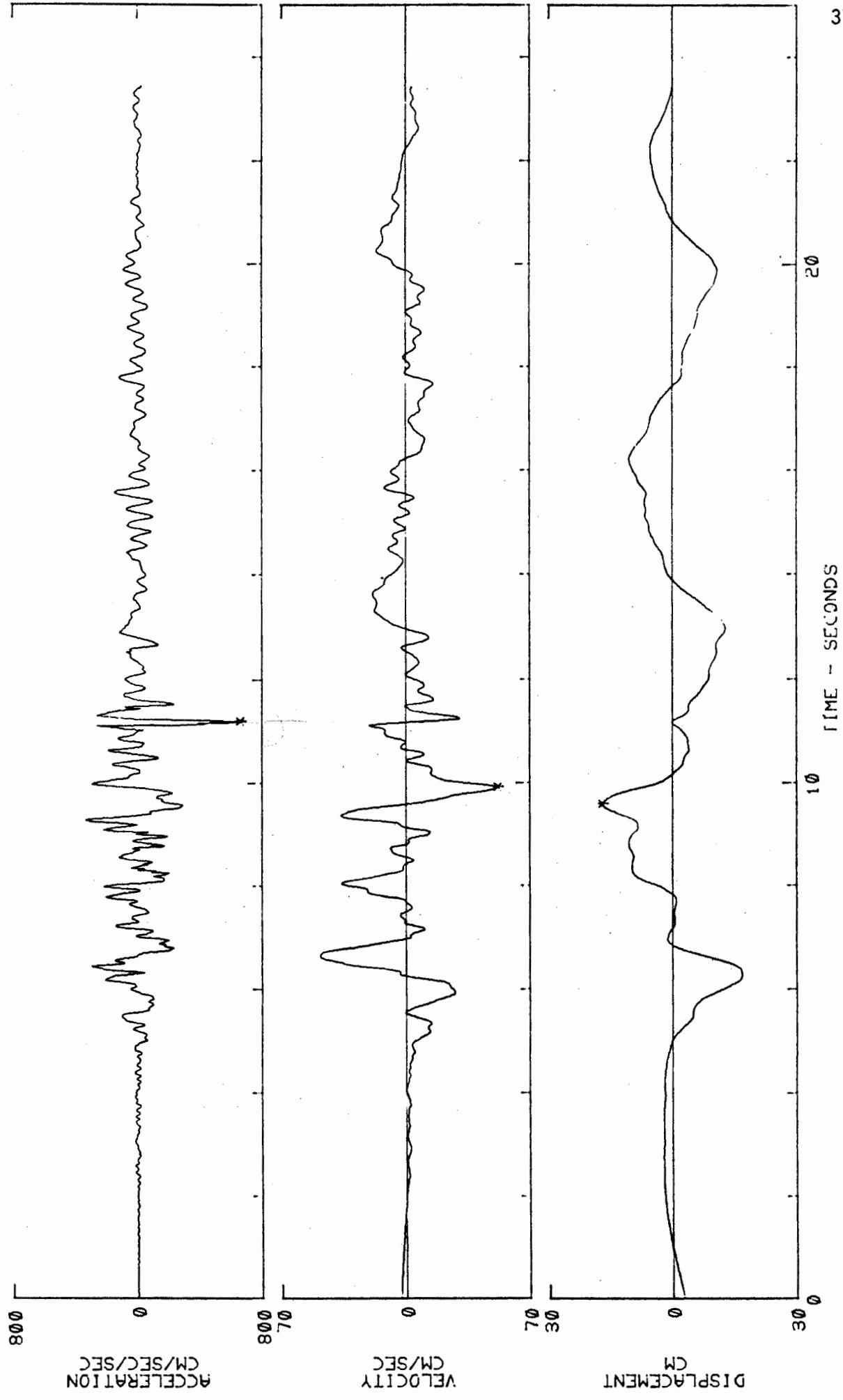
IMPERIAL VALLEY EARTHQUAKE, EL CENTRO, CAL. OCT 15, 1979 -1616 PDT
 IIA001 79.001.0 IMPERIAL COUNTY SERVICE BLDG., 2/F C, EL CENTRO, CALIFORNIA
 TRACE 8
 ACCELEROGRAM IS BAND-PASS FILTERED BETWEEN 0.095-0.125 AND 25.00-27.00 CYC/SEC.
 *PEAK VALUES : ACCELERATION = -306.3 CM/SEC/SEC VELOCITY = 46.8 CM/SEC DISPLACEMENT = 19.2 CM



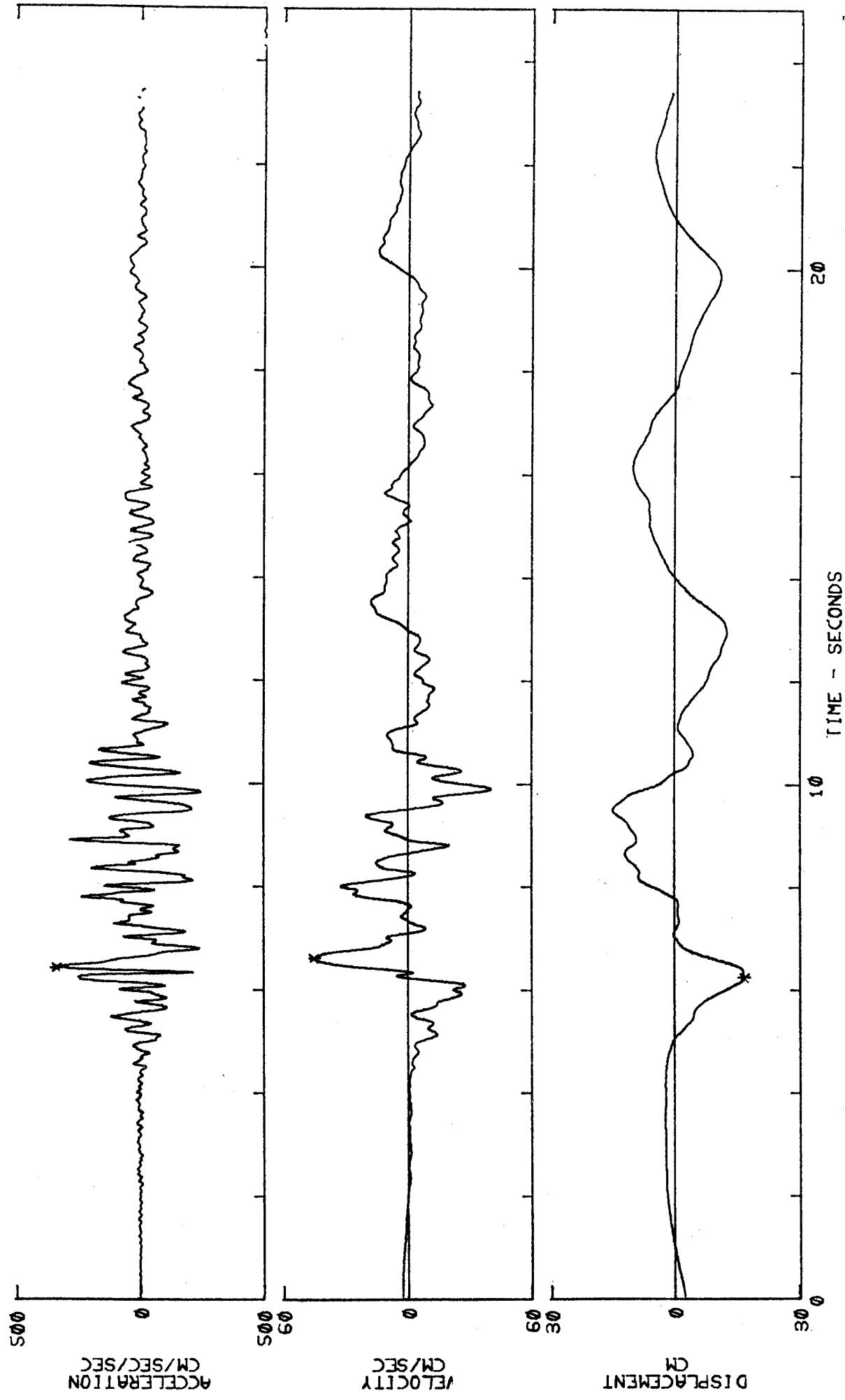
IMPERIAL VALLEY EARTHQUAKE. FL CENTRO. CAL. OCT 15, 1979 -1616 PDT
TA001 '79.001.0 IMPERIAL COUNTY SERVICE BLDG., 2/F R, FL CENTRO, CALIFORNIA TRACE 9

ACCELEROMGRAM IS BAND-PASS FILTERED BETWEEN 0.095-0.125 AND 25.00-27.00 CYC/SEC.

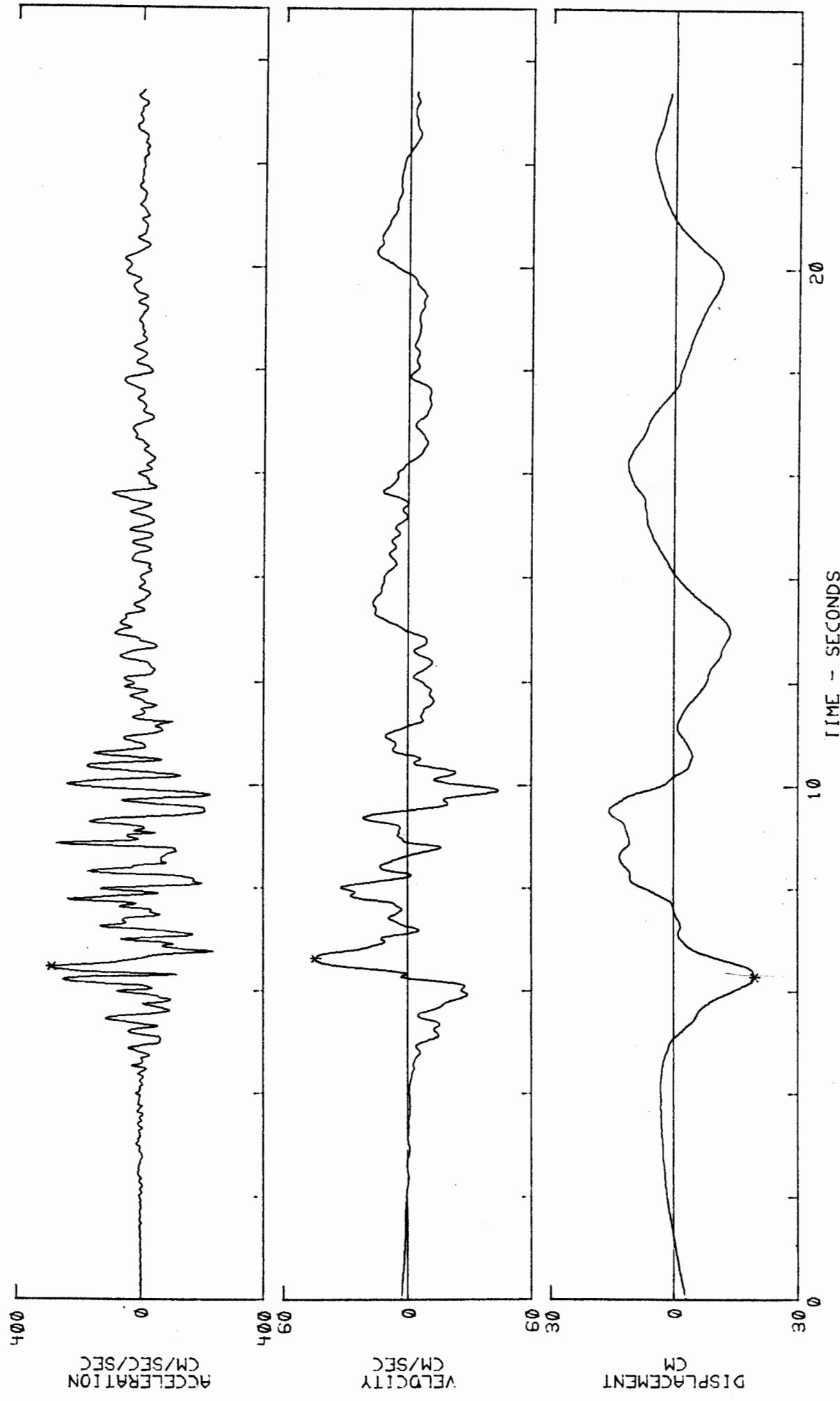
*PEAK VALUES : ACCELERATION = 655.9 CM/SEC/SEC VELOCITY = 51.6 CM/SEC DISPLACEMENT = -17.1 CM

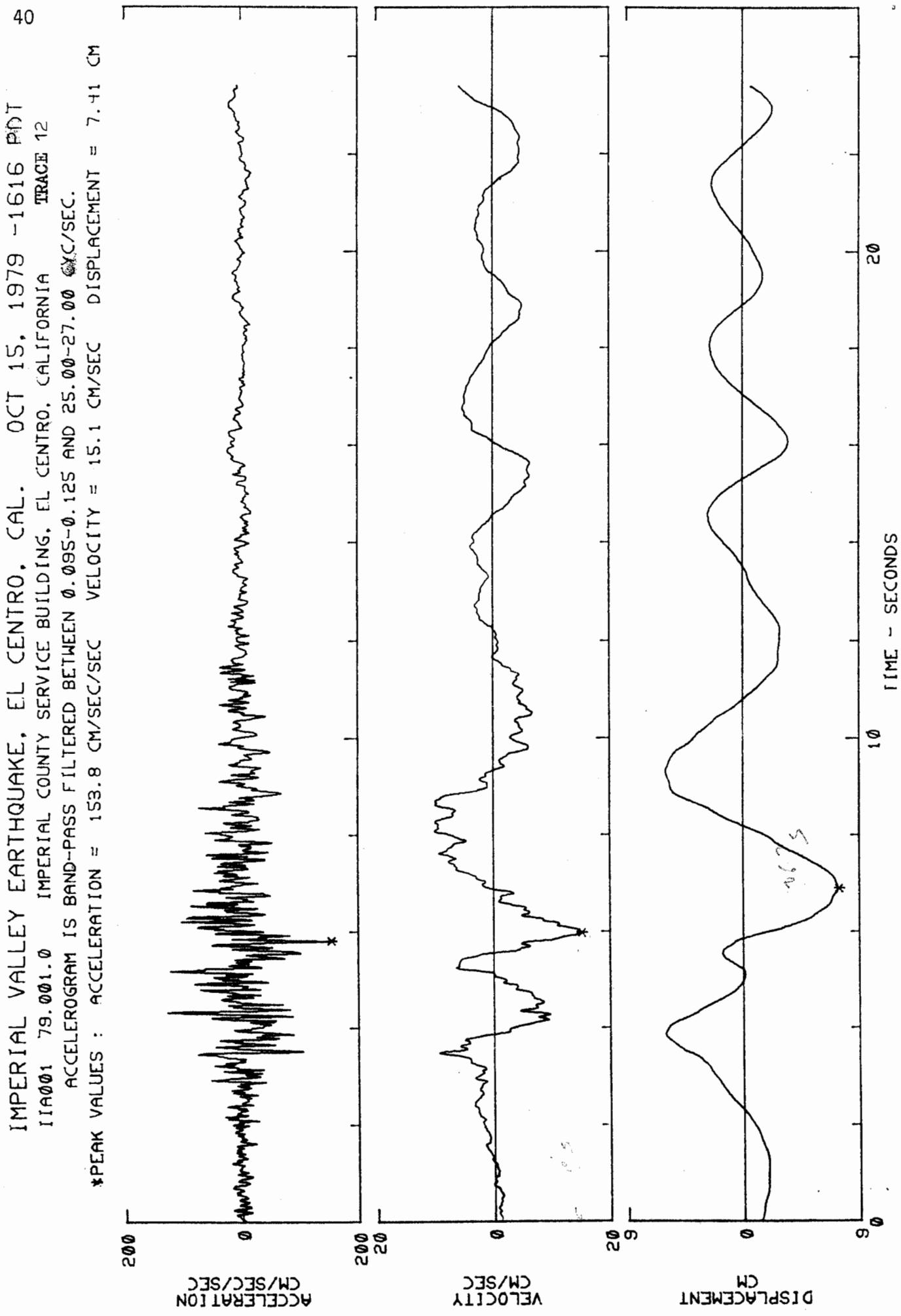


IMPERIAL VALLEY EARTHQUAKE, EL CENTRO, CAL. OCT 15, 1979 -1616 PDT
 IIA001 79.001.0 IMPERIAL COUNTY SERVICE BLDG., G/F L. EL CENTRO, CALIFORNIA TRACE 10
 ACCELEROMGRAM IS BAND-PASS FILTERED BETWEEN 0.095-.25 AND 25.00-27.00 CYC/SEC.
 *PEAK VALUES : ACCELERATION = -339.1 CM/SEC/SEC VELOCITY = -45.1 CM/SEC DISPLACEMENT = 16.9 CM

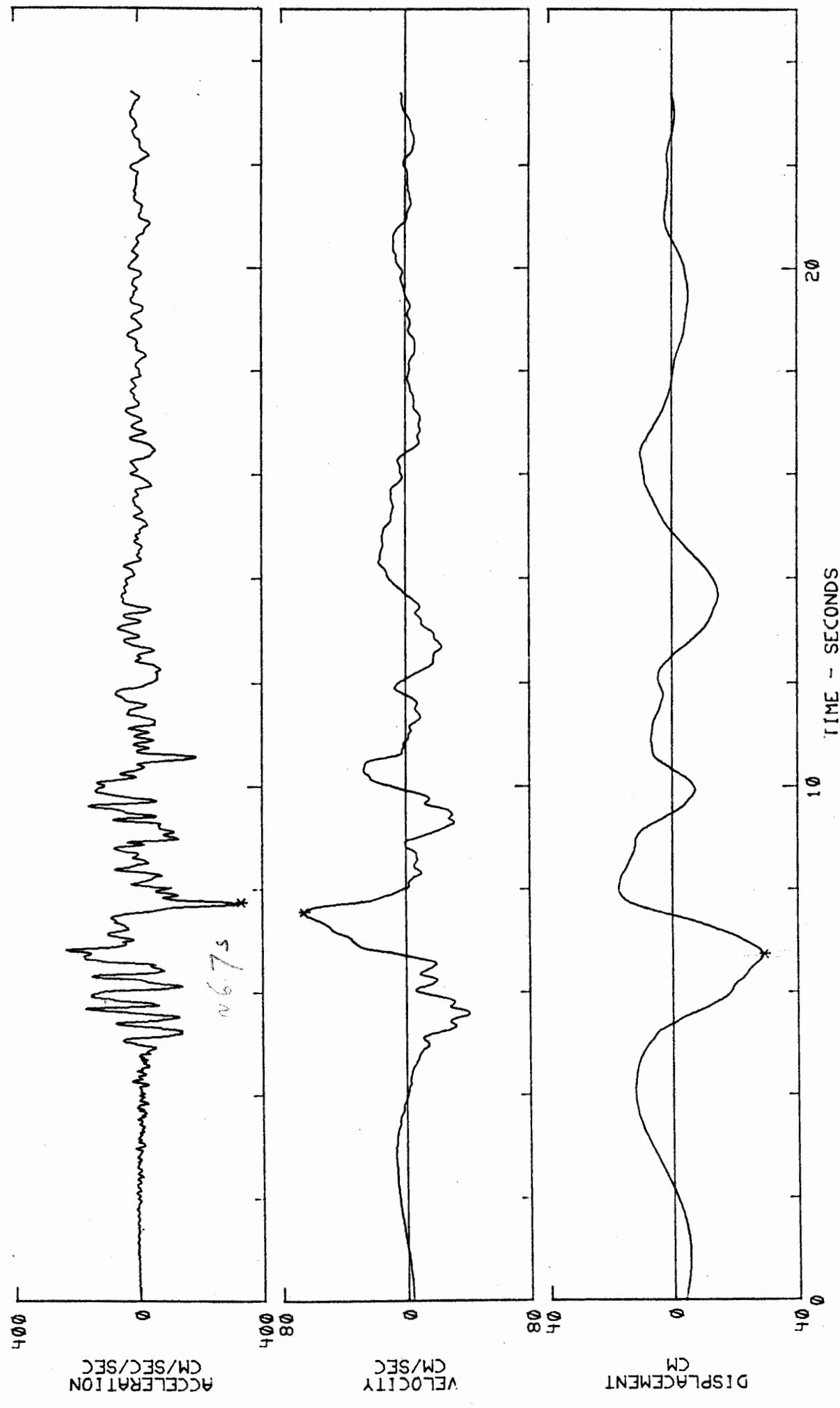


IMPERIAL VALLEY EARTHQUAKE, EL CENTRO, CAL. OCT 15, 1979 -1616 PDT
TAKE 01 79.001.0 IMPERIAL COUNTY SERVICE BUILDING, EL CENTRO, CALIFORNIA TRACE 11
ACCELEROMGRAM IS BAND-PASS FILTERED BETWEEN 0.095-0.125 AND 25.00-27.00 CYC/SEC.
*PEAK VALUES : ACCELERATION = -288.2 CM/SEC/SEC VELOCITY = -44.8 CM/SEC DISPLACEMENT = 19.4 CM





IMPERIAL VALLEY EARTHQUAKE, EL CENTRO, CAL. OCT 15, 1979 -1616 PDT
11A001 79.001.0 IMPERIAL COUNTY SERVICE BUILDING, EL CENTRO, CALIFORNIA TRACE 13
ACCELEROGRAM IS BAND-PASS FILTERED BETWEEN 0.095-0.125 AND 25.00-27.00 CYC/SEC.
*PEAK VALUES : ACCELERATION = 331.5 CM/SEC/SEC VELOCITY = -66.2 CM/SEC DISPLACEMENT = 29.1 CM

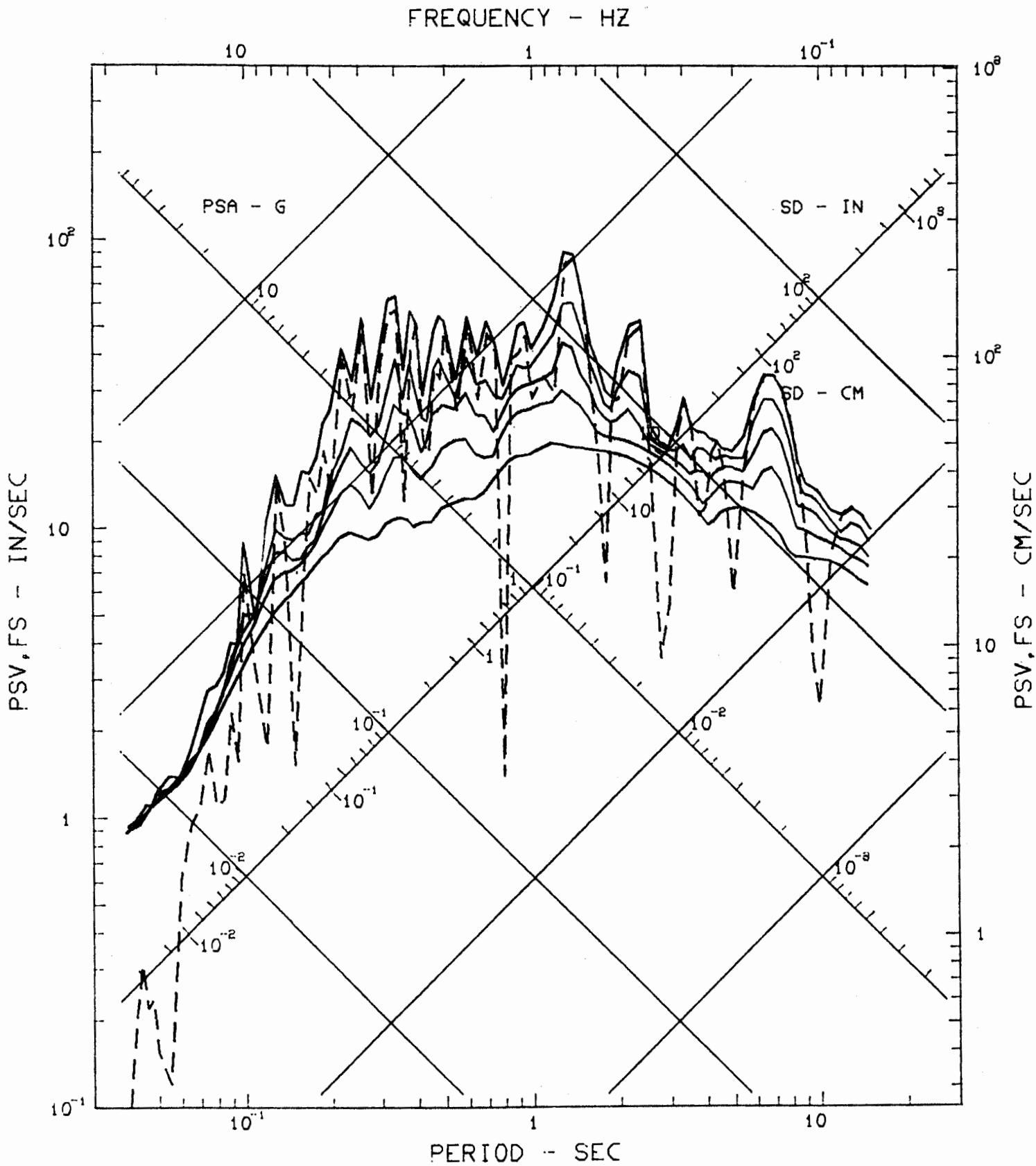


RESPONSE AND FOURIER SPECTRA

IMPERIAL VALLEY EARTHQUAKE, EL CENTRO, CAL. OCT 15, 1979 -1616 PD

III A001 79.001.0 IMPERIAL COUNTY SERVICE BLDG., G/F L, EL CENTRO, CALIFORNIA TRACE
 ACCELEROGRAM IS BAND-PASS FILTERED BETWEEN 0.050-0.070 AND 25.00-27.00 CYC/SEC.
 DAMPING VALUES ARE 0, 2, 5, 10 & 20 % OF CRITICAL

— RESPONSE SPECTRA: PSV, PSA & SD - - - FOURIER AMPLITUDE SPECTRUM: FS



RESPONSE AND FOURIER SPECTRA

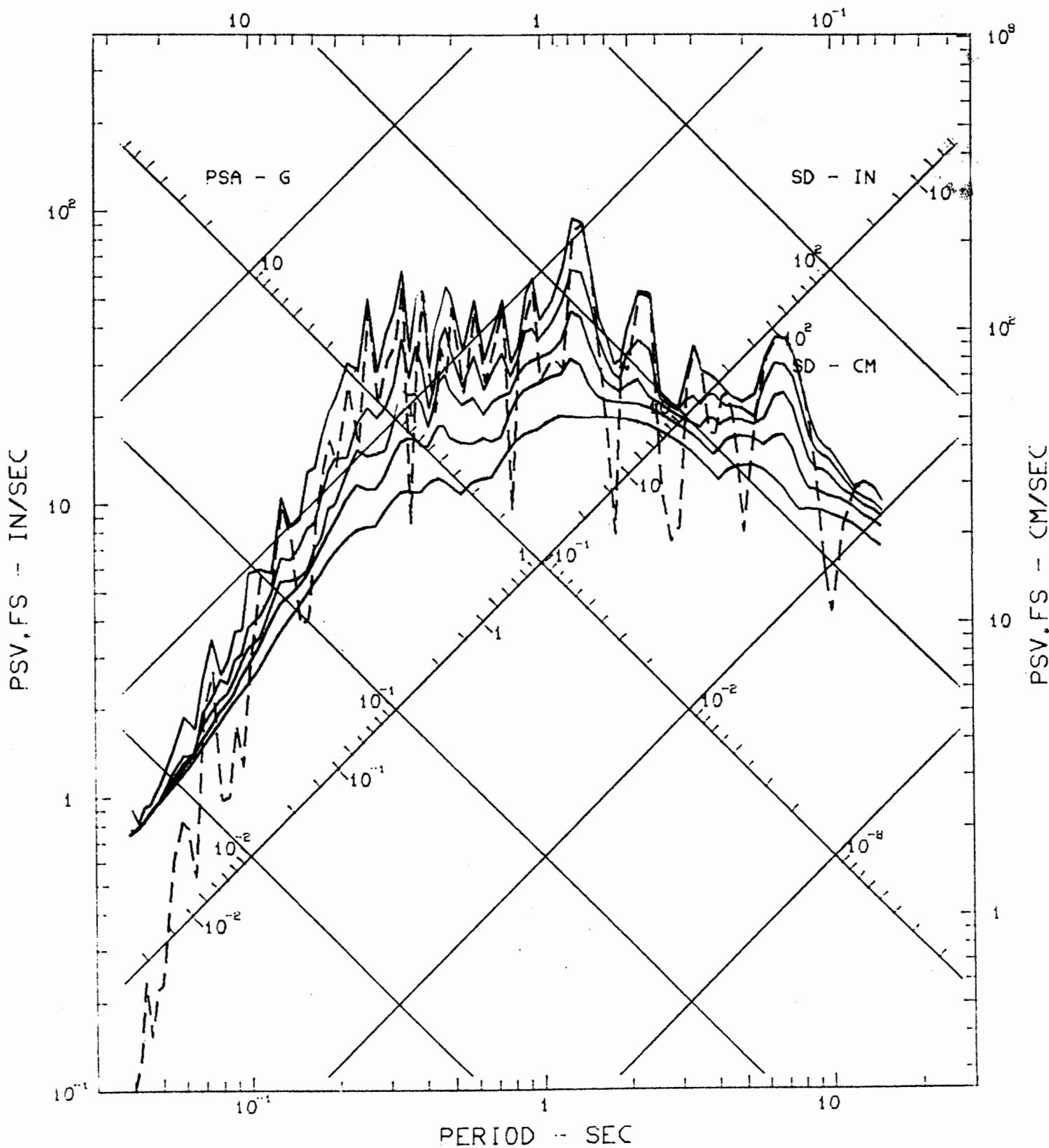
43

IMPERIAL VALLEY EARTHQUAKE, EL CENTRO, CAL. OCT 15, 1979 -1616 PDT

IIIA001 79.001.0 IMPERIAL COUNTY SERVICE BUILDING, EL CENTRO, CALIFORNIA TRACE 11.
 ACCELEROGRAM IS BAND-PASS FILTERED BETWEEN 0.050-0.070 AND 25.00-27.00 CYC/SEC.
 DAMPING VALUES ARE 0, 2, 5, 10 & 20 % OF CRITICAL

— RESPONSE SPECTRA: PSV, PSA & SD — — — FOURIER AMPLITUDE SPECTRUM: FS

FREQUENCY - HZ



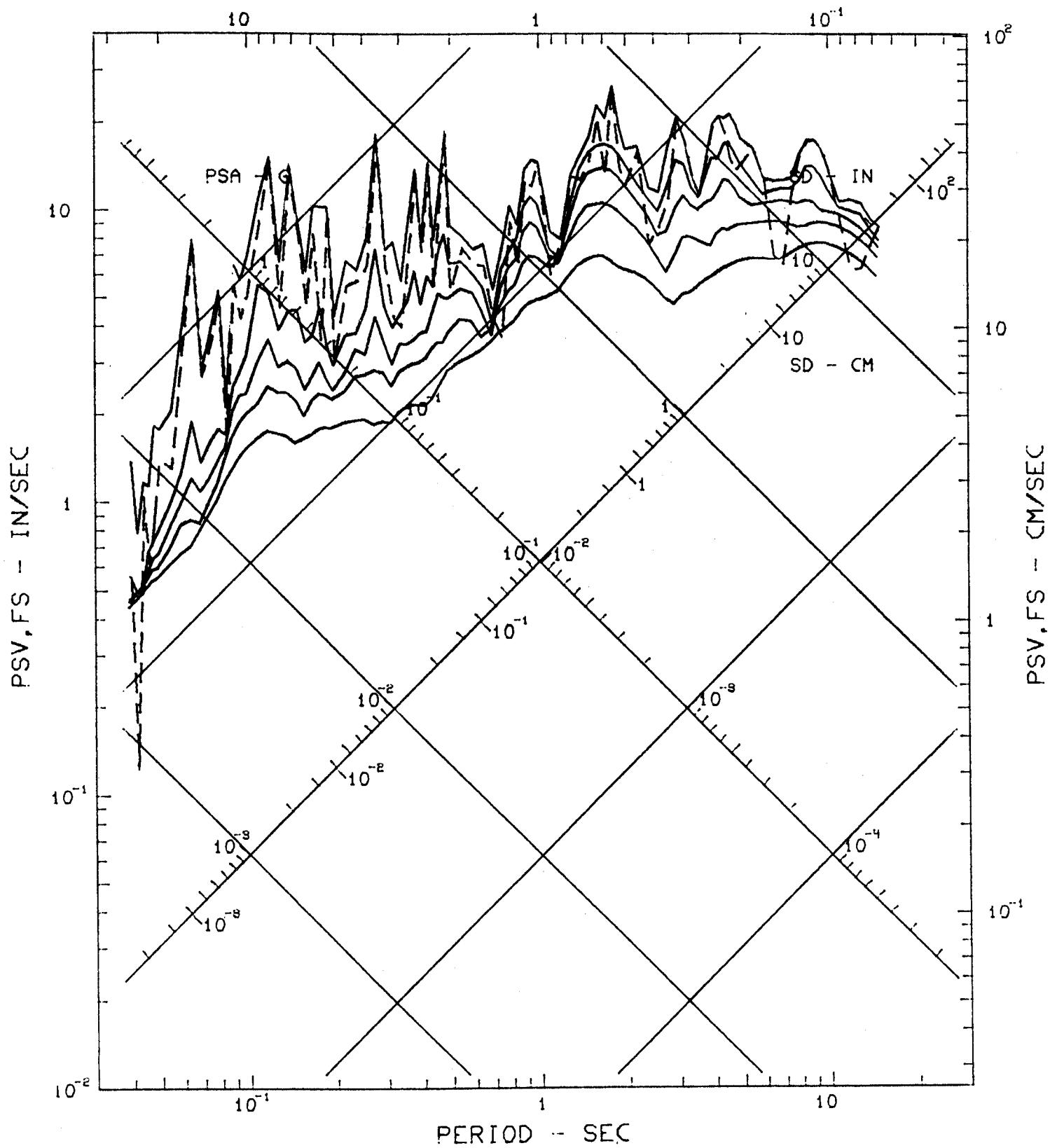
RESPONSE AND FOURIER SPECTRA

IMPERIAL VALLEY EARTHQUAKE, EL CENTRO, CAL. OCT 15, 1979 -1616 PDT

IIIA001 79.001.0 IMPERIAL COUNTY SERVICE BUILDING, EL CENTRO, CALIFORNIA TRACE 12
 ACCELEROGRAHM IS BAND-PASS FILTERED BETWEEN 0.050-0.070 AND 25.00-27.00 CYC/SEC.
 DAMPING VALUES ARE 0, 2, 5, 10 & 20 % OF CRITICAL

— RESPONSE SPECTRA: PSV, PSA & SD - - - FOURIER AMPLITUDE SPECTRUM: FS

FREQUENCY - HZ



RESPONSE AND FOURIER SPECTRA

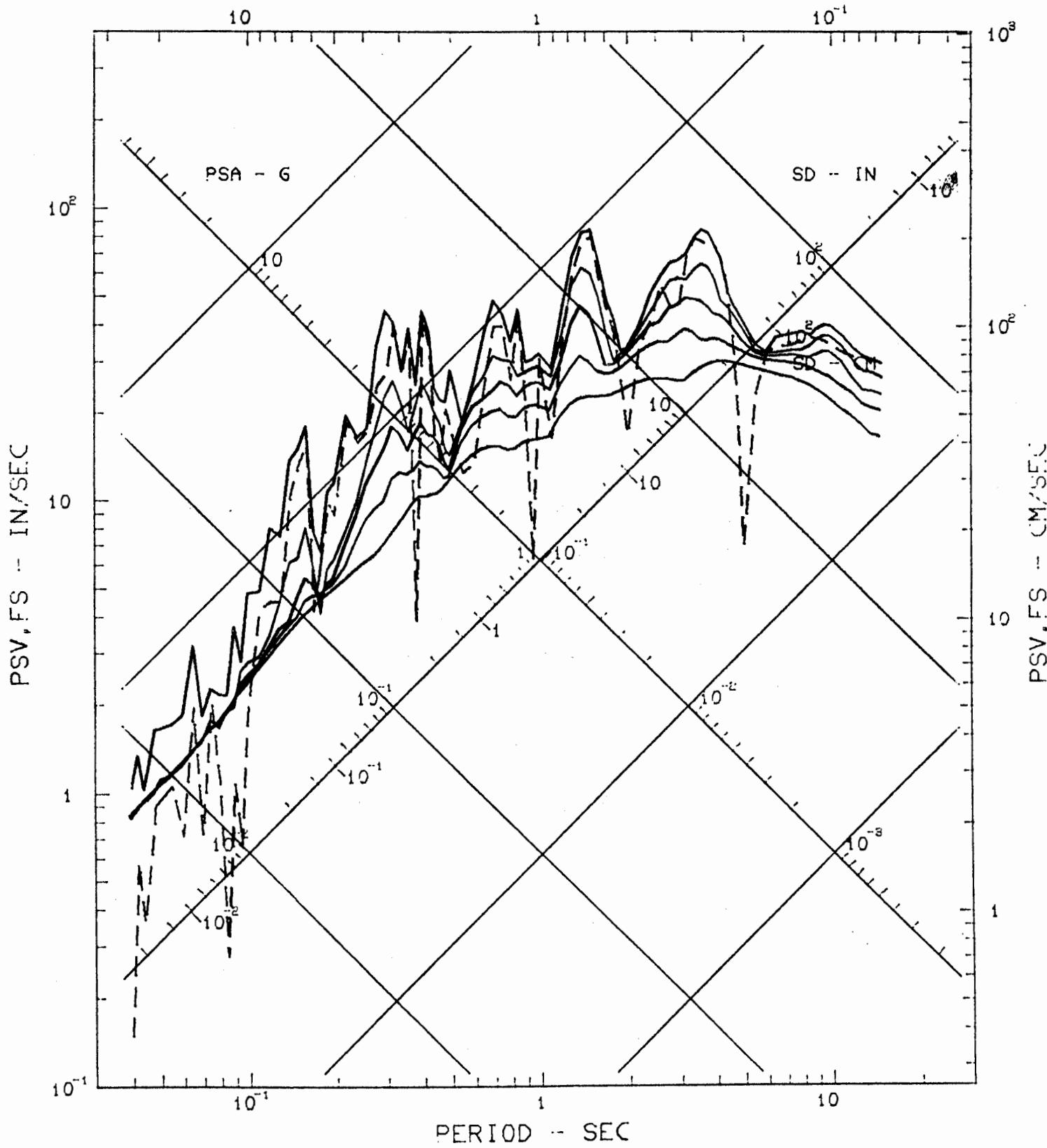
45

IMPERIAL VALLEY EARTHQUAKE, EL CENTRO, CAL. OCT 15, 1979 -1616 PDT

III A001 79.001.0 IMPERIAL COUNTY SERVICE BUILDING, EL CENTRO, CALIFORNIA TRACE 13
 ACCELEROGRAM IS BAND-PASS FILTERED BETWEEN 0.050-0.070 AND 25.00-27.00 CYC/SEC.
 DAMPING VALUES ARE 0, 2, 5, 10 & 20 % OF CRITICAL

— RESPONSE SPECTRA: PSV, PSA & SD - - - FOURIER AMPLITUDE SPECTRUM: FS

FREQUENCY — HZ



STRONG-MOTION RECORD DATA

STATION DATAName E1 Centro-Rt.8/Meloland Overpass Owner CDMGAddress E1 Centro, CaliforniaCounty ImperialNumber: CDMG 336 USGS -Coordinates: Latitude 32.773 °N; Longitude 115.448 °W

Instrument(s)

Type (traces)	Serial Number	Date Installed	Date Removed
CR-1 1-13	<u>164(master)</u>	<u>4/26/78</u>	<u>-</u>
CR-1 14-26	<u>165(slave)</u>	<u>4/26/78</u>	<u>-</u>
_____	_____	_____	_____
_____	_____	_____	_____

EARTHQUAKE DATAName (Region) Imperial Valley earthquakeDate 15 October 1979 Epicentral Distance: 18.3 kmSITE GEOLOGY

Site underlain by Quaternary lake bed deposits that are intercalated with alluvial fill of Salton Trough. Perpendicular distance to Imperial fault is 0.5 km.

TRACE EVALUATION/DATA

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% Crit)	Peak Acc. (% g)
1	UP	17.8	51.1	62	17.2
2	W	17.3	51.6	62	32.6
3	W	17.3	51.1	65	48.5
4	N	17.6	52.5	62	27.9
5	W	16.6	53.8	62	51.5
6	UP	17.2	53.5	66	19.6
7	W	17.4	51.5	64	50.9
8	N	16.5	53.9	64	38.5
9	W	16.9	53.8	66	49.7
10	UP	16.8	54.5	65	27.4
11	W	17.0	54.2	64	42.2
12	N	17.3	53.9	61	27.7
13	W	17.1	53.4	63	46.8

Structural orientation reference: North = 360 °

STRONG-MOTION RECORD DATA

STATION DATA

Name E1 Centro-Rt.8/Meloland Overpass Owner CDMG
 Address E1 Centro, California

County Imperial
 Number: CDMG 336 USGS
 Coordinates: Latitude 32.773 °N; Longitude 115.448 °W
 Instrument(s)
 Type (traces) Serial Number Date Installed Date Removed
CR-1 (1-13) 164 (master) 4/26/78 _____
CR-1 (14-26) 165 (slave) 4/26/78 _____
 _____ _____ _____ _____
 _____ _____ _____ _____

EARTHQUAKE DATA

Name (Region) Imperial Valley earthquake
 Date 15 October 1979 Epicentral Distance: 18.3 km

SITE GEOLOGY

Site underlain by Quaternary lake bed deposits that are intercalated with alluvial fill of Salton Trough. Perpendicular distance to Imperial fault is 0.5 km.

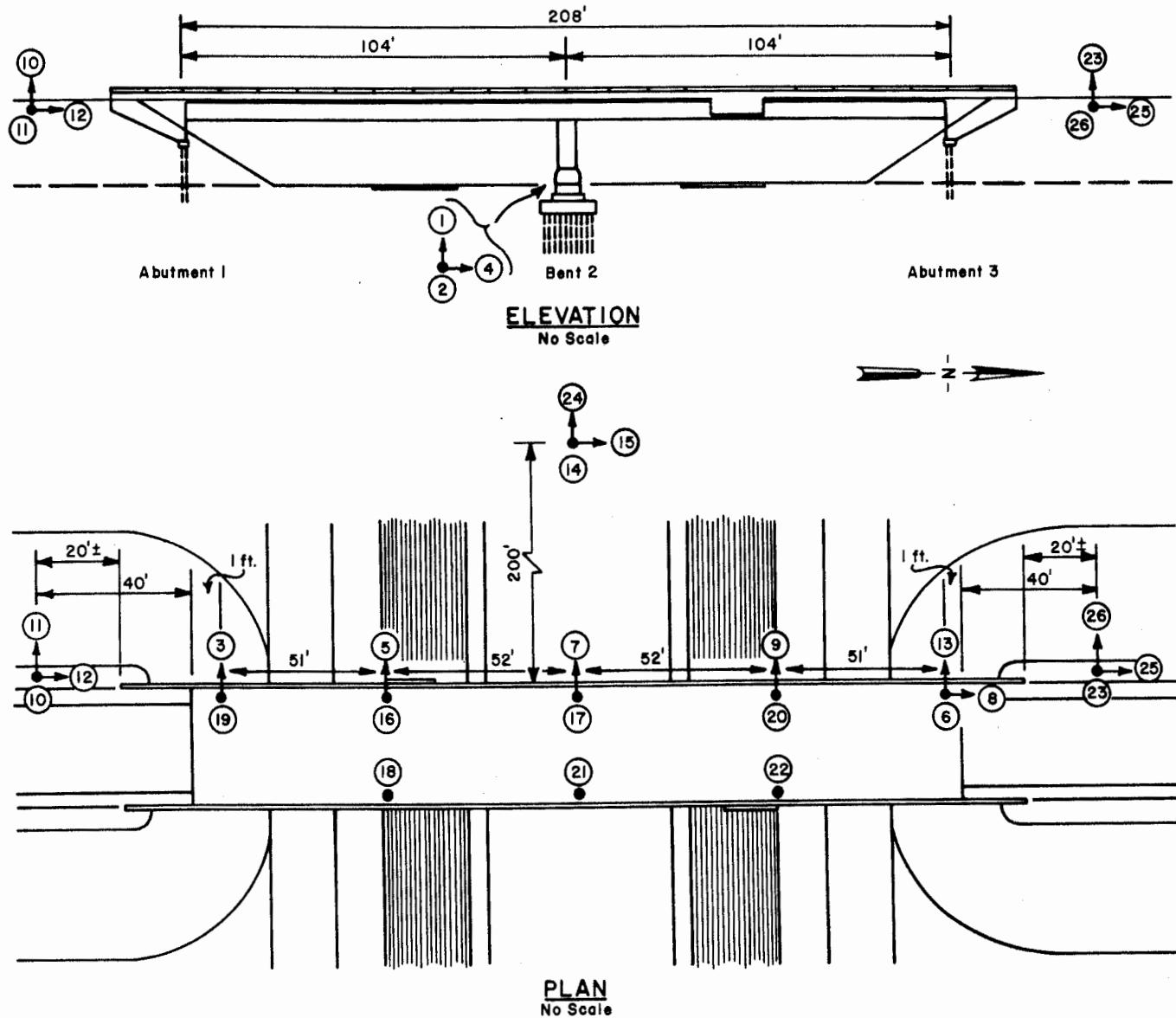
TRACE EVALUATION/DATA

Trace (from top)	Orientation	Sensitivity (mm/g)	Nat Freq (Hz)	Damping (% Crit)	Peak Acc. (% g)
14	UP	18.1	50.6	61	23.1
15	N	17.6	52.3	66	31.8
16	UP	17.7	51.7	63	50.3
17	UP	17.4	50.9	61	22.5
18	UP	18.0	52.5	63	44.3
19	UP	17.6	52.4	62	21.2
20	UP	17.4	53.3	62	44.7
21	UP	18.1	50.7	64	22.9
22	UP	18.0(est.)	50.7	61	40.8*
23	UP	17.5	51.9	66	25.1
24	W	17.4	52.8	64	29.6
25	N	17.3	50.7	64	35.0
26	W	17.1	51.0	64	38.5

*Approximation

Structural orientation reference: North = 360 °

**El Centro
ROUTE 8/MELOLAND OVERPASS
Strong Motion Instrumentation Scheme**



EL CENTRO RT. 8/MELOLAND OVERPASS
STATION 32.773°N-115.448°W
EQ 10/15/79 EQ 32.62°N-115.33°W

CDMG #3336 26 Chs. Copy Scale (1cm)
CR-1/164 (master) Film Speed = 2 time mark/sec
Mag 6.6 (CIT)

1 GROUND UP

2 GROUND W

3 DECK W

4 GROUND N

5 DECK W

6 DECK UP

7 DECK W

8 DECK N

9 DECK W

10 APP UP

11 APP W

12 APP N

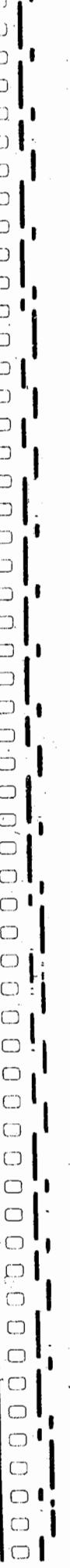
13 DECK W

49

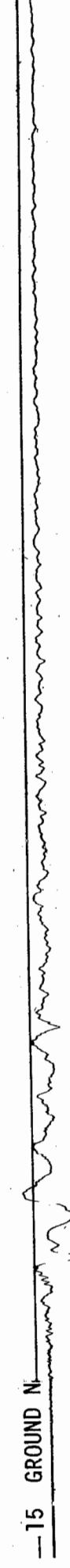
EL CENTRO RT. 8/MELOLAND OVERPASS
STATION 32.773°N/115.448°W
EQ 10/15/79 EQ 32.62°N-115.33°W

CDMG #3336 26 Chs. Copy Scale (1cm)
CR-1/165 (slave) Film Speed = 2 time mark/sec
Mag 6.6 (CIT)

14 GROUND UP



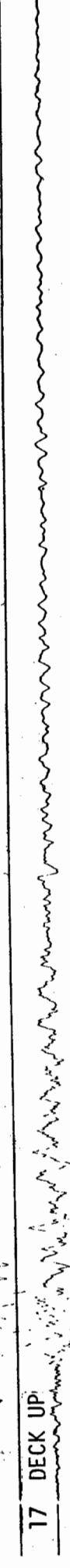
15 GROUND N



16 DECK UP



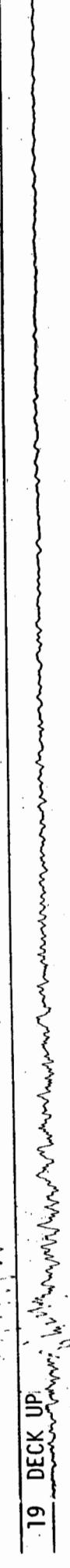
17 DECK UP



18 DECK UP



19 DECK UP



20 DECK UP



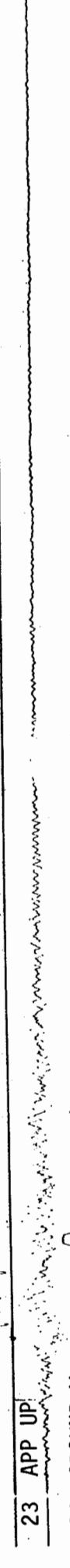
21 DECK UP



22 DECK UP



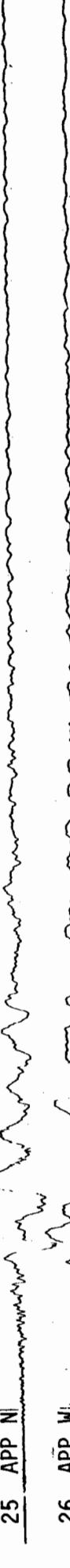
23 APP UP



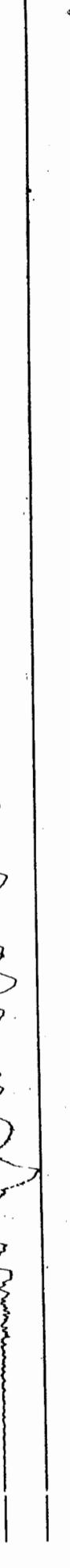
24 GROUND W



25 APP N



26 APP W



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Preliminary Report 26
1980